Assessment of Cogeneration Opportunities in Selected Ontario Industrial Plants

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EXECUTIVE SUMMARY

Cogeneration is the sequential production of electrical and heat energy, by a generation plant. This report is concerned with the opportunities for cogeneration in Ontario industry.

The Ministry of Energy is interested in promoting cogeneration, for the following reasons:

(1) Cogeneration can increase Ontario's electrical generating capacity, without the construction of large, new, centralized generating stations and new high-voltage transmission lines.

(2) Cogeneration uses fuel much more efficiently than conventional equipment.

(3) Because cogeneration is more efficient than conventional generation, environmental ommissions from cogeneration plants are less than the emissions from equivalent conventional equipment.

This report follows the February, 1987 report to the Ministry of Energy, by Acres International Ltd., titled "Cogeneration Potential in Ontario, and Barriers to its Development".

The assignment for this report was to evaluate the technical and financial viability of installing privately owned cogeneration systems in a cross-section of industrial plants in Ontario.

The two prime objectives were as follows:

(1) Characterize financially feasible cogeneration systems applicable to industry.

(2) Identify actions which could be taken by the Ministry of Energy to remove impediments to the development of private sector cogeneration projects.

The analysis of cogeneration opportunities was based on audits of Ontario industrial plants, technical and financial analysis of multiple cogeneration scenarios for each plant, and review of the results with the plant personnel.

The intent was to expose the real or perceived impediments to private sector acceptance of the capital investment opportunities, and to examine Ministry of Energy actions that would best serve the specific needs of the investor, and the broader requirements of the province.

The overall exercise has demonstrated the following significant findings:

(1) Good interest exists at the plant level.

(2) Ontario has many technically feasible cogeneration possibilities.

(3 The study discovered some financially feasible projects.

(4) A number of other projects would require some form of increased financial benefits to be financially feasible at present.

(5) Some companies have thermal load requirements that are conducive to cogeneration systems, but they have production capital investment requirements, which take precedence over non-essential investments, such as for cogeneration.

(6) Plant operators are not convinced that Ontario Hydro and the local P.U.C.'s want to receive independently generated power nor that the rates offered are equitable.

1.0 INTRODUCTION

1.1 Background

Cogeneration is the simultaneous production of electricity and usable heat as part of a common process. The electricity can be used on-site, sold to the Electric Utility or a combination of the two. Typically the heat is used in steam or hot water form, but there are other forms of heat utilization.

The industrial sector is a major user of electricity in Ontario. In 1985, this sector used 33 billion kWh of electricity or 29% of the total electricity used. Continued growth and increased use of electrotechnologies will push the industrial consumption to approximately 40 billion kWh by the year 2000.

A prior report (*) assessed that 1300 MW of cogeneration facilities would be commissioned in Ontario by the year 2000 if the current information, institutional and financial barriers remained. Almost all of the cogeneration potential was deemed to be in the industrial sector.

Ontario faces increasing demands for electric power, in the late 1980's and early 1990's. Industrial cogeneration is an excellent opportunity to increase Ontario's capacity to generate electric power, delaying the need for Ontario Hydro to build more large generating stations, or high voltage transmission lines.

Part of the Minisitry of Energy mandate is to assist the industrial sector in improving energy efficiency. Cogeneration is one of the potential mechanisms for effecting energy improvement.

1.2 Objective

The objective of this assignment was to expand the current public information base by examining different forms and sizes of cogeneration opportunities in various industrial sectors. It was hoped that it would be possible to characterize applications for ranking the areas and types of systems with the greatest opportunity for satisfying corporate financial return thresholds.

1.3 Methodology

The analysis is based on actual facilities where mini-audits were conducted. Based on the electrical consumption and thermal use data, various cogeneration

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(*) Cogeneration Potential in Ontario, and Barrier to its Development, prepared for the Ministry of Energy by Acres International Ltd., 1987.

scenarios were evaluated and the financial viability determined by computer for ten years of operation. The technical and financial analysis data was then presented to plant personnel to get reactions and to record real or perceived barriers to proceeding. The following was noted during this process:

- How the interpretation of technical cogeneration opportunities by plant personnel differs from our own. This was specifically intended to uncover barriers based on lack of information or poor information.

- The requirements for corporately approving a cogeneration project as well as the reasons (if any) why current circumstances were not acceptable.

- Plant attitudes regarding the operation of a cogeneration system.

- Positive and negative reactions to the technical and financial analysis were interpreted to try to assign the factors according to industry, size, geographical location, as well as outside factors including the economy, future energy demand and cost trends, plus utility policies and actions etc.

In the process of gathering real data, financially analyzing it, reviewing it with the plant owner, and noting and interpreting their responses, a list of potential Government initiatives that would enhance the acceptance of cogeneration in the Industrial Sector was developed.

In summary, the approach was to make the cogeneration assessments for different industrial sectors very practical in terms of identifying what cogeneration systems make the most technical and financial sense, what are the major barriers to the use of cogeneration systems and how can the barriers be removed or at least minimized.

2.0 COGENERATION SYSTEM ANALYSIS

2.1 Cogeneration Systems Data

The plant electrical consumption and thermal use data and the various cogeneration system configurations are contained in Section 3.0. The basis for the analysis work is described in the following sections.

2.2 Plant Input Data

Electrical Purchase Price represents the blended consumption and demand charges obtained from the plant for 1988. It is escalated according to the factors provided in Section 2.4.

Initial Fuel Cost is the 1988 fuel cost reported by the plant and it escalated according to the factors provided in Section 2.4.

Boiler Efficiency represents the current plant efficiency for the steam or hot water which would be displaced by the usable heat from the cogeneration system. This factor, in conjunction with the fuel cost, establishes the monetary value of the usable heat.

Other components of the input data for each computer run reflect information obtained from the plant, but they are not "pure" numbers obtained from the plant.

2.3 Computer Printout Technical Terms

A computer printout sheet is included in the report for each cogeneration scenario. The basis for the technical data is as follows:

Size is the rating of the generator. In the case of a gas turbine the kW generation rate and fuel rate (Gross Heat Rate) will move upwards or downwards with variations in the atmospheric pressure and temperature conditions. The values used are those provided in the manufacturers' catalogues.

Usable Heat represents the energy recovered from the operation of a gas turbine, steam turbine or gas engine. It is in steam or hot water form.

Electrical Load Factor used for the computer printouts is a weighted average that has been manually calculated from the plant data. Electrical generation may be reduced for reasons as follows:

- System unavailable due to scheduled or nonscheduled maintenance.
- Thermal load in plant is less than available heat from cogeneration system with the resulting operating decision to reduce the generation rate or shut down the cogeneration system.

- In the case where power is not being sold to the utility the load factor could be adjusted to reflect lower plant electrical demand during periods of the year.

Thermal Load Factor relates to the Electrical Load Factor and identifies the percentage of usable heat that is utilized on an annual basis. On a weighted basis it can compensate for losses and periods of time (if any) when the electrical generation would be allowed to exceed the corresponding usable heat.

Electricity Used On-site represents the annual determination of the displaced electricity normally purchased expressed as a percentage of the total amount generated on-site by the system being analyzed.

Construction Period represents the time from the final corporate decision to proceed until the system is commissioned. Two years has been allowed to cover equipment deliveries, building modifications, coordination time with the Electric Utilities and obtaining approval from regulatory bodies.

2.4 Financial Analysis Factors

The financial analysis for each cogeneration scenario involves many common assumptions which are summarized in this section.

- Equipment for cogeneration projects is **Federal and Provincial Sales Tax exempt**.

- Projects are **internally financed** with no external loans.

- The natural gas purchase price was obtained from each plant with the cost escalating each year according to data obtained from the Ministry of Energy. The **natural gas escalation factors** were as follows:

ESCALATION RATES
(Per cent)

Year	Fuel Cost
1989	3.4 *
1990	0.6 *
1991	2.1
1992	2.4
1993	4.0
1994	4.2
1995	3.7 *
1996	-0.5
1997	-0.5
1998	-0.5
1999	-0.5
2000	-0.26 *

* Represents data obtained from the Ministry of Energy with the intermediate year factors being interpolated.

. The electricity purchase price was obtained from each plant. The **electricity purchase escalation factors**, which were obtained from Ontario Hydro, are as follows:

ESCALATION RATES
(Per cent)

Year	Purchased Electricity
1989	5.6
1990	4.5
1991	4.0
1992	4.0
1993	4.0
1994	4.0
1994	4.0
1995	4.0
1996	4.3
1997	4.3
1998	4.3
1999	4.3

. For projects up to 5 MW in size the electricity sale prices (Utility buy-back prices) are published by Ontario Hydro. The price is determined by the **capacity factor** which is defined by Ontario Hydro as "the ratio between 1) the total kilowatt hours delivered in the month and 2) the product of the peak kilowatts delivered and the number of hours in the month." The two 1988 rates were as follows:

- $0.0376/kWh when the capacity factor is at or above 65%
- $0.0254/kWh when the capacity factor is below 65%

It is important to recognize that a cogeneration system **sized to essentially satisfy on-site requirements** will in practice never qualify for the higher rate. Assume that a plant required 90% of the cogeneration system electrical capacity when producing and 10% capacity during a shutdown mode. Also assume that the cogeneration system operated 100% of the time because the available "usable heat" was required. This would mean that plant production could only take place 40% of the time or 8 full shifts per week to qualify for the $0.0376/kWh rate. Thus, the preferred capacity factor electricity rate could only be satisfied if the plant had an unusually low accrued production time per week.

The Ontario Hydro rate structure does not preclude the design of an electrical generation system which exceeds plant demand and on a regular basis supplies a relatively constant percentage of surplus power back to the Electric Utility at the higher $0.0376/kWh rate. Disregarding unscheduled downtime and assuming constant sale amounts during production periods allows the conditions to be generalized for the monthly calculation periods as follows:

Production Operation	Weekly Non-Production			
Days/Week	Days/Week	Maximum % Capacity Sale to Satisfy 65% Capacity Factor		
		Refer to Note A	Refer to Note B	Refer to Note C
5.0	2.0	98	78.4	39.2
5.5	1.5	90	72.0	36.0
6.0	1.0	84.5	67.6	33.8

Note A: If it is assumed that 50% of the cogeneration system capacity was surplus to the plant production needs and sold back to the Electrical Utility during production periods then this column represents the maximum per cent of system capacity which can be sold on the weekend while still preserving the higher $0.0376/kWh rate.

Note B: Per Note A but using 40% of system capacity as the constant sale amount during production periods. This column represents of surplus production the maximum weekend per cent of system capacity that could be sold to the Electric Utility and still preserve the $0.0376/kWh rate.

Note C: Per Note A but, using 20% of system capacity as the surplus sold during production periods.

- Electricity **sale prices** must be negotiated with Ontario Hydro when the cogeneration system capacity exceeds 5 MW. Lacking a fixed rate structure, the rates for smaller (less than 5 MW) systems have been used.

- Ontario Hydro uses the Consumer Price Index to escalate the electricity sale price (Utility buy-back price). The **electricity sale escalation factors** based on the Ontario average consumer price index are as follows:

ESCALATION RATES
(Per cent)

Year	Sale Electricity
1989	4.8
1990	4.6
1991	4.5
1992	4.5
1993	4.5
1994	4.5
1995	4.5
1996	5.0
1997	5.0
1998	5.0
1999	5.0

- The **Capital Cost Allowance (CCA)** for each scenario is based on the following classifications:

a) **Class 34 Accelerated Capital Cost Allowance**

This allowance applies to a system which simultaneously produces thermal energy and electricity which is the case for cogeneration systems. A common 90% of the total capital cost is used for the three year accelerated write off in increments of 25%, 50% and 25%. Currently the CCA stream is triggered by capital cost expenditures and this is the way the computer program treats this allowance. It is expected that there will be draft legislation in 1990 that would prevent the CCA claims from being triggered until the system was operating (Availability Rule). The future impact of this potential legislation is demonstrated by sensitivity runs in Section 5.2.

b) **Class 3 Declining Balance Capital Cost Allowance**

The new 4% declining balance rate has been used. This CCA claim is triggered now by the expenditure of capital costs, but it would be subject to the same Availability Rule if the proposed changes are implemented.

- The percentage of the capital cost applicable to the Class 34 capital cost allowance will be high and will vary according to site circumstances. Building and foundation project costs cannot qualify for accelerated write-off without a special ruling from Revenue Canada. Each scenario has been treated uniformly as follows:

Class	**% of Capital Cost**
Class 34	90
Class 3	10

- The **Investment Tax Credit** decreased to 3% of the capital investment in 1989 and is zero in 1990. Thus, it has not been incorporated into the analysis.

- **Annual Insurance Costs** have been calculated at the rate of 0.8% of the total project capital cost.

- **Annual Operating and Maintenance** (O & M) **Costs** are based on a cross-section of supplier recommendations as follows:

  - Gas Turbine/Generator Sets- $0.003/kWh
  - Steam Turbine/Generator Sets- $0.001/kWh
  - Internal Combustion Engines- $0.008/kWh

- The Operating and Maintenance (O & M) costs have been escalated in accordance with the Consumer Price Index. The **O & M cost escalation factors** are as follows:

ESCALATION RATES
(Per cent)

Year	O & M Expenses
1989	4.8
1990	4.6
1991	4.5
1992	4.5
1993	4.5
1994	4.5
1995	4.5
1996	5.0
1997	5.0
1998	5.0
1999	5.0

- **Corporate taxes** are calculated at the current rate of 44.34%

- The **Discount Rate** has been set at 13% for the net present value determinations of "profit after tax" and "cumulative cash flow". This represents the prime rate plus cost of money currently available to established corporations.
- The **Internal Rate of Return** has been determined for each scenario and by definition this disregards the previous "discount rate".
- A **ten year life cycle** has been used.

3.0 COGENERATION SCENARIO ANALYSIS

Each sub number of Section 3.0 represents a different plant. Plants are identified by Standard Industrial Classification (SIC) numbers established for the major manufacturing groups.

For each plant, electrical and thermal use patterns are described with respect to peak demand and annual consumption. The weekly and summer/winter load patterns are also briefly described, in the form available.

Multiple cogeneration scenarios were analyzed for each plant with the number of scenarios being dependent on plant energy load opportunities and the desire of this report to demonstrate cogeneration system differences.

A series of sensitivity runs are provided in Section 5.2 to provide the reader with an appreciation of the impact of various changes.

3.1 GROUP 30 - RUBBER AND MISCELLANEOUS PLASTIC PRODUCTS

a) Background Plant Data

The plant operates a weekly cycle of 5½ days of production and 1½ downtime days for implementing production changes and maintenance.

The electrical demand was analyzed for summer and winter months. The results for the production operation can be generalized as follows:

PRODUCTION PERIOD DATA	DEMAND IN kW SUMMER	WINTER
Maximum Demand Daily Greatest	13,829	13,939
Maximum Demand Daily Smallest	8,994 (1)	12,612
Minimum Demand Daily Greatest	8,596	8,871
Minimum Demand Daily Smallest	1,507 (2)	7,002

(1) Occurred on Monday with mid-week "smallest" being 6,847 kW.

(2) Occurred on Friday with the mid-week "smallest" being 6,847 kW.

Notes 1 and 2 suggest the summer "daily smallest" demand figures may have been caused by transferring from or to the weekend mode at a time that was different than normal.

The thermal energy demand requirements can be generalized from steam usage data covering the period from September 1987 to August 1988.

- Summer average steam load: 31,764 lbs/hr
- Winter average steam load: 66,486 lbs/hr

There are several cogeneration system configurations which could be considered. These are covered in the following sections.

b) Cogeneration Scenarios

- Scenario 3.1A involves the installation of a packaged natural gas fired gas turbine/generator set. Maximum electrical output is 8,589 kW and a heat recovery steam boiler generates a maximum of 42,500 lbs/hr of steam. Surplus electricity is sold back to the Utility.

- **Scenario 3.1B** involves the cogeneration equipment complement covered by 3.1A but covers the case where electricity is not sold to the Utility.
- **Scenario 3.1C** involves the installation of a packaged natural gas fired gas turbine/generator set. Maximum electrical output is 3,028 kW and a heat recovery steam boiler generates a maximum of 18,600 lbs/hr of steam. Surplus electricity is sold to the Utility.
- **Scenario 3.1D** involves the cogeneration equipment complement covered by 3.1C, but covers the case where electricity is not sold to the Utility.
- **Scenario 3.1E** is the same as 3.1D except that the heat recovery steam generator is equipped to permit supplemental firing in the turbine exhaust stream. The maximum capacity of this steam generating unit is 53,600 lbs/hr of steam.
- **Scenario 3.1F** is the same as 3.1E except that a larger turbine/generator and boiler are used. The boiler is supplementally fired to increase steam output. The nominal electrical output of the system is 3,743 kW and steam is generated at a rate of 39,600 lbs/hr.
- **Scenario 3.1G** is the same as 3.1A with respect to the cogeneration system. The improved financial performance results from the acknowledgement that this company has a second plant and that surplus power could be "wheeled" to the plant to get the benefit of higher valued kWh's.

This plant has surplus low pressure steam which often precludes the use of existing turbine driven equipment. Unless a back pressure steam turbine exhausted steam at the current generation pressure level it would compete with the existing plant turbines. Thus, steam turbine scenarios were not evaluated in detail.

c) **Summary of Results**

Separate "Cogeneration System Cash Flow Analysis" sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1A Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:

Installed Cost:	7681 $(1000)			Elec. Purchase Price:	4.50 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	7681 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	81.50 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	64.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2462.0	2560.5	2662.9	2769.4	2880.2	2995.4	3124.2	3258.5	3398.7	3544.8
Electricity Sold:			780.2	815.3	852.0	890.4	930.4	972.3	1020.9	1072.0	1125.6	1181.9
Thermal Use:			1493.8	1525.3	1561.4	1624.5	1692.3	1755.4	1746.4	1737.3	1728.3	1719.3
TOTAL REVENUES: $(1000)			4736.0	4901.1	5076.4	5284.3	5502.9	5723.1	5891.6	6067.9	6252.6	6446.0
EXPENSE												
Fuel:			2740.2	2798.0	2864.3	2980.1	3104.3	3220.1	3203.7	3187.0	3170.5	3154.0
O&M:			223.5	233.5	244.0	255.0	266.5	278.5	292.4	307.0	322.4	338.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			3025.1	3095.8	3175.5	3305.2	3444.1	3575.2	3576.5	3578.5	3581.5	3585.5
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1710.9	1805.4	1900.9	1979.1	2058.8	2147.9	2315.1	2489.4	2671.1	2860.4
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-480.3	328.4	831.0	866.2	901.9	941.9	1016.4	1094.1	1175.1	1259.4
PROFIT(After Tax):$(1000)	312.0	1086.2	2191.2	1477.0	1069.9	1113.0	1156.9	1206.0	1298.6	1395.3	1496.0	1601.0
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1716.0	1023.6	656.2	604.1	555.7	512.6	488.5	464.5	440.7	417.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-4091.6	-2614.6	-1544.7	-431.7	725.1	1931.2	3229.8	4625.1	6121.1	7722.1
(based on profit NPV)	-2760.4	-5877.6	-4161.5	-3137.9	-2481.7	-1877.6	-1322.0	-809.3	-320.9	143.6	584.3	1001.7

SIMPLE PAYBACK: 4.5 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.1 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 16.95%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1B

Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:
Installed Cost: 7512 $(1000)
Loan Amount: 0 $(1000)
Down Payment 7512 $(1000)
Loan Terms:
  Int. 12.0 %
  Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 8589.0 kW
Gross Heat Rate: 11165.0 Btu/kWh
Usable Heat: 5011.0 Btu/kWh
Load Factors:
  Electrical: 64.0 %
  Thermal: 62.0 %

Elec. Purchase Price: 4.50 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 81.50 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2486.9	2586.3	2689.8	2797.4	2909.3	3025.7	3155.8	3291.5	3433.0	3580.6
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			945.0	965.0	987.8	1027.8	1070.6	1110.5	1104.9	1099.1	1093.4	1087.7
TOTAL REVENUES: $(1000)			3431.9	3551.3	3677.6	3825.1	3979.9	4136.2	4260.6	4390.6	4526.4	4668.3
EXPENSE												
Fuel:			1771.5	1808.8	1851.7	1926.5	2006.8	2081.7	2071.1	2060.3	2049.6	2038.9
O&M:			144.5	151.0	157.8	164.9	172.3	180.0	189.0	198.5	208.4	218.8
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			60.1	62.8	65.6	68.6	71.7	74.9	78.6	82.6	86.7	91.0
TOTAL EXPENSES: $(1000)			1976.0	2022.6	2075.1	2159.9	2250.8	2336.6	2338.7	2341.4	2344.7	2348.8
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1455.9	1528.7	1602.6	1665.2	1729.1	1799.6	1921.9	2049.2	2181.7	2319.6
[Depreciation]:(Class 34)	676.1	2366.3	2704.3	1014.1								
[Depreciation]:Class 3(4%)	12.0	29.6	28.4	27.2	26.2	25.1	24.1	23.1	22.2	21.3	20.5	19.7
TAXES: 44.34 percent	-305.1	-1062.3	-566.1	216.1	699.0	727.2	756.0	787.7	842.3	899.2	958.3	1019.8
PROFIT(After Tax):$(1000)	305.1	1062.3	2022.0	1312.6	903.6	938.0	973.1	1011.9	1079.6	1150.1	1223.4	1299.8
PROFIT PRESENT VALUE (After Tax):$(1000)	305.1	940.1	1583.5	909.7	554.2	509.1	467.4	430.1	406.1	382.8	360.4	338.8
CUMULATIVE CASH FLOW (NPV): $(1000)	-2699.7	-6144.6	-4122.5	-2809.9	-1906.3	-968.3	4.8	1016.7	2096.3	3246.3	4469.8	5769.6
(based on profit NPV)	-2699.7	-5748.3	-4164.7	-3255.0	-2700.8	-2191.7	-1724.3	-1294.2	-888.1	-505.2	-144.8	194.0

SIMPLE PAYBACK: 5.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 10.3 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 13.82%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1C Prime Mover: Solar "Centaur" gas turbine

ASSUMPTIONS:
Installed Cost: 3869 $(1000)
Loan Amount: 0 $(1000)
Down Payment 3869 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 3028.0 kW
Gross Heat Rate: 13243.0 Btu/kWh
Usable Heat: 6224.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.50 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 81.50 %
Elec. Used On Site: 85.00 %
Electricity Sale Price: 2.54 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1152.8	1198.9	1246.8	1296.7	1348.6	1402.5	1462.8	1525.7	1591.3	1659.8
Electricity Sold:			114.6	119.8	125.2	130.8	136.7	142.8	150.0	157.5	165.3	173.6
Thermal Use:			654.1	667.9	683.7	711.3	741.0	768.7	764.7	760.8	756.8	752.9
TOTAL REVENUES: $(1000)			1921.5	1986.5	2055.7	2138.8	2226.3	2314.0	2377.5	2443.9	2513.5	2586.2
EXPENSE												
Fuel:			1145.8	1170.0	1197.7	1246.1	1298.1	1346.5	1339.7	1332.7	1325.8	1318.9
O&M:			78.8	82.3	86.0	89.9	93.9	98.2	103.1	108.2	113.6	119.3
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			31.0	32.3	33.8	35.3	36.9	38.6	40.5	42.5	44.7	46.9
TOTAL EXPENSES: $(1000)			1255.6	1284.7	1317.6	1371.4	1429.0	1483.3	1483.2	1483.5	1484.1	1485.1
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			665.9	701.9	738.1	767.5	797.3	830.7	894.3	960.5	1029.4	1101.1
[Depreciation]:(Class 34)	348.2	1218.7	1392.8	522.3								
[Depreciation]:Class 3(4%)	6.2	15.2	14.6	14.0	13.5	12.9	12.4	11.9	11.4	11.0	10.5	10.1
TAXES: 44.34 percent	-157.1	-547.1	-328.8	73.4	321.3	334.6	348.0	363.1	391.5	421.0	451.8	483.8
PROFIT(After Tax):$(1000)	157.1	547.1	994.7	628.5	416.8	432.9	449.3	467.7	502.8	539.5	577.6	617.4
PROFIT PRESENT VALUE (After Tax):$(1000)	157.1	484.2	779.0	435.6	255.6	235.0	215.8	198.8	189.1	179.6	170.2	161.0
CUMULATIVE CASH FLOW (NPV): $(1000)	-1390.5	-3164.7	-2170.0	-1541.5	-1124.7	-691.8	-242.5	225.1	728.0	1267.5	1845.1	2462.5
(based on profit NPV)	-1390.5	-2960.6	-2181.6	-1746.0	-1490.4	-1255.4	-1039.6	-840.8	-651.7	-472.1	-301.9	-141.0

SIMPLE PAYBACK: 5.6 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 11.2 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 11.81%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1D — Prime Mover: Solar "Centaur" gas turbine

ASSUMPTIONS:

Installed Cost:	3702 $(1000)			Elec. Purchase Price:	4.50 cents/kWh
Loan Amount:	0 $(1000)	Size:	3028.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	3702 $(1000)	Gross Heat Rate:	13243.0 Btu/kWh	Boiler Efficiency:	81.50 %
Loan Terms:		Usable Heat:	6224.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	85.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	84.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1164.4	1211.0	1259.4	1309.8	1362.2	1416.7	1477.6	1541.1	1607.4	1676.5
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			560.7	572.5	586.1	609.7	635.2	658.8	655.5	652.1	648.7	645.3
TOTAL REVENUES: $(1000)			1725.1	1783.5	1845.5	1919.5	1997.3	2075.5	2133.1	2193.2	2256.1	2321.8
EXPENSE												
Fuel:			983.8	1004.6	1028.4	1069.9	1114.5	1156.1	1150.2	1144.2	1138.3	1132.4
O&M:			67.6	70.7	73.9	77.2	80.7	84.3	88.5	92.9	97.6	102.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			29.6	30.9	32.3	33.8	35.3	36.9	38.8	40.7	42.7	44.9
TOTAL EXPENSES: $(1000)			1081.1	1106.2	1134.6	1180.9	1230.5	1277.3	1277.5	1277.8	1278.6	1279.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			644.0	677.3	710.9	738.6	766.8	798.2	855.6	915.4	977.5	1042.2
[Depreciation]:(Class 34)	333.2	1166.1	1332.7	499.8								
[Depreciation]:Class 3(4%)	5.9	14.6	14.0	13.4	12.9	12.4	11.9	11.4	10.9	10.5	10.1	9.7
TAXES: 44.34 percent	-150.4	-523.5	-311.6	72.8	309.5	322.0	334.7	348.9	374.5	401.2	429.0	457.8
PROFIT(After Tax):$(1000)	150.4	523.5	955.6	604.5	401.4	416.6	432.1	449.3	481.1	514.2	548.6	584.4
PROFIT PRESENT VALUE (After Tax):$(1000)	150.4	463.3	748.4	419.0	246.2	226.1	207.5	191.0	181.0	171.2	161.6	152.3
CUMULATIVE CASH FLOW (NPV): $(1000)	-1330.4	-3028.1	-2072.5	-1468.0	-1066.6	-650.0	-217.9	231.4	712.5	1226.7	1775.2	2359.6
(based on profit NPV)	-1330.4	-2832.8	-2084.5	-1665.5	-1419.3	-1193.2	-985.6	-794.6	-613.7	-442.5	-280.9	-128.6

SIMPLE PAYBACK: 5.6 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 11.2 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 11.86%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1E

Prime Mover: Solar "Centaur" gas turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost: 4320 $(1000)
Loan Amount: 0 $(1000)
Down Payment 4320 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 3028.0 kW
Gross Heat Rate: 24571.0 Btu/kWh
Usable Heat: 17922.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.50 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 81.50 %
Elec. Used On Site: 85.00 %
Electricity Sale Price: 2.54 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1152.8	1198.9	1246.8	1296.7	1348.6	1402.5	1462.8	1525.7	1591.3	1659.8
Electricity Sold:			114.6	119.8	125.2	130.8	136.7	142.8	150.0	157.5	165.3	173.6
Thermal Use:			1883.5	1923.2	1968.8	2048.3	2133.7	2213.3	2202.0	2190.6	2179.2	2167.9
TOTAL REVENUES: $(1000)			3150.8	3241.9	3340.8	3475.8	3619.0	3758.7	3814.8	3873.8	3935.9	4001.2
EXPENSE												
Fuel:			2126.0	2170.9	2222.3	2312.1	2408.5	2498.3	2485.6	2472.7	2459.8	2447.0
O&M:			78.8	82.3	86.0	89.9	93.9	98.2	103.1	108.2	113.6	119.3
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			34.6	36.1	37.7	39.4	41.2	43.1	45.2	47.5	49.9	52.3
TOTAL EXPENSES: $(1000)			2239.3	2289.3	2346.1	2441.4	2543.7	2639.6	2633.9	2628.4	2623.3	2618.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			911.5	952.6	994.7	1034.4	1075.3	1119.1	1180.9	1245.4	1312.6	1382.5
[Depreciation]:(Class 34)	388.8	1360.8	1555.2	583.2								
[Depreciation]:Class 3(4%)	6.9	17.0	16.3	15.7	15.0	14.4	13.9	13.3	12.8	12.3	11.8	11.3
TAXES: 44.34 percent	-175.5	-610.9	-292.6	156.8	434.4	452.3	470.7	490.3	518.0	546.8	576.8	608.0
PROFIT(After Tax):$(1000)	175.5	610.9	1204.2	795.7	560.3	582.2	604.7	628.8	663.0	698.6	735.8	774.5
PROFIT PRESENT VALUE (After Tax):$(1000)	175.5	540.6	943.0	551.5	343.7	316.0	290.4	267.3	249.4	232.6	216.8	201.9
CUMULATIVE CASH FLOW (NPV): $(1000)	-1552.5	-3533.6	-2329.5	-1533.7	-973.4	-391.2	213.4	842.2	1505.2	2203.8	2939.6	3714.2
(based on profit NPV)	-1552.5	-3305.7	-2362.7	-1811.2	-1467.5	-1151.6	-861.1	-593.9	-344.5	-111.9	104.9	306.8

SIMPLE PAYBACK: 4.9 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 15.23%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.1F

Prime Mover: Solar "Centaur Type H" gas turbine with supplemental firing

ASSUMPTIONS:

Installed Cost:	4737 $(1000)			Elec. Purchase Price:	4.50 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	4737 $(1000)	Gross Heat Rate:	16821.0 Btu/kWh	Boiler Efficiency:	81.50 %
Loan Terms:		Usable Heat:	10709.0 Btu/kWh	Elec. Used On Site:	82.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1374.7	1429.7	1486.8	1546.3	1608.2	1672.5	1744.4	1819.4	1897.7	1979.3
Electricity Sold:			170.0	177.7	185.7	194.0	202.7	211.9	222.5	233.6	245.3	257.5
Thermal Use:			1391.2	1420.5	1454.2	1513.0	1576.0	1634.8	1626.5	1618.0	1609.6	1601.3
TOTAL REVENUES: $(1000)			2935.9	3027.9	3126.7	3253.3	3387.0	3519.2	3593.4	3671.0	3752.5	3838.0
EXPENSE												
Fuel:			1799.1	1837.1	1880.6	1956.6	2038.2	2114.2	2103.4	2092.5	2081.6	2070.8
O&M:			97.4	101.8	106.3	111.1	116.1	121.4	127.4	133.8	140.5	147.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			37.9	39.6	41.4	43.2	45.2	47.2	49.6	52.1	54.7	57.4
TOTAL EXPENSES: $(1000)			1934.4	1978.4	2028.3	2110.9	2199.5	2282.8	2280.4	2278.3	2276.7	2275.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1001.5	1049.4	1098.4	1142.3	1187.5	1236.4	1313.0	1392.7	1475.8	1562.4
[Depreciation]:(Class 34)	426.3	1492.2	1705.3	639.5								
[Depreciation]:Class 3(4%)	7.6	18.6	17.9	17.2	16.5	15.8	15.2	14.6	14.0	13.5	12.9	12.4
TAXES: 44.34 percent	-192.4	-669.9	-320.0	174.1	479.7	499.5	519.8	541.8	576.0	611.6	648.6	687.3
PROFIT(After Tax):$(1000)	192.4	669.9	1321.5	875.3	618.7	642.8	667.7	694.7	737.0	781.1	827.2	875.1
PROFIT PRESENT VALUE (After Tax):$(1000)	192.4	592.8	1034.9	606.6	379.4	348.9	320.7	295.3	277.2	260.0	243.7	228.1
CUMULATIVE CASH FLOW (NPV): $(1000)	-1702.4	-3874.7	-2553.2	-1677.9	-1059.2	-416.4	251.3	946.0	1683.0	2464.1	3291.3	4166.4
(based on profit NPV)	-1702.4	-3624.8	-2589.9	-1983.3	-1603.8	-1254.9	-934.2	-638.9	-361.7	-101.7	142.0	370.2

SIMPLE PAYBACK: 4.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 15.44%
(Based on 10 Years)

```
                              COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.1G          Prime Mover:      Solar "Mars" gas turbine

ASSUMPTIONS:
Installed Cost: 7681 $(1000)                                             Elec. Purchase Price:        4.50 cents/kWh
Loan Amount:       0 $(1000)      Size:                 8589.0 kW        Initial Fuel Cost:           3.10 $/MMBtu
Down Payment    7681 $(1000)      Gross Heat Rate:     11165.0 Btu/kWh   Boiler Efficiency:          81.50 %
Loan Terms:                       Usable Heat:          5011.0 Btu/kWh   Elec. Used On Site:        100.00 %
      Int.      12.0 %            Load Factors:                          Electricity Sale Price:      0.00 cents/kWh
      Term       6.0 Years           Electrical:          99.0 %         Construction Period:         2.00 year(s)
Discount Rate:  13.0%                Thermal:             98.0 %         O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
======================================================================================================================

YEAR:                           1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE
      Displaced Electricity:                  3846.9  4000.7  4160.8  4327.2  4500.3  4680.3  4881.6  5091.5  5310.4  5538.8
      Electricity Sold:                          0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
      Thermal Use:                            1493.8  1525.3  1561.4  1624.5  1692.3  1755.4  1746.4  1737.3  1728.3  1719.3
TOTAL REVENUES: $(1000)                       5340.6  5526.0  5722.2  5951.7  6192.6  6435.7  6628.0  6828.8  7038.7  7258.1

EXPENSE
      Fuel:                                   2740.2  2798.0  2864.3  2980.1  3104.3  3220.1  3203.7  3187.0  3170.5  3154.0
      O&M:                                     223.5   233.5   244.0   255.0   266.5   278.5   292.4   307.0   322.4   338.5
      P&I:                                       0.0     0.0     0.0     0.0     0.0     0.0
      Insurance:                                61.4    64.2    67.1    70.1    73.3    76.6    80.4    84.4    88.6    93.1
TOTAL EXPENSES: $(1000)                       3025.1  3095.8  3175.5  3305.2  3444.1  3575.2  3576.5  3578.5  3581.5  3585.5

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                      2315.5  2430.3  2546.7  2646.5  2748.5  2860.5  3051.5  3250.3  3457.2  3672.5

[Depreciation]:(Class 34)      691.3  2419.5  2765.2  1036.9

[Depreciation]:Class 3(4%)      12.3    30.2    29.0    27.9    26.7    25.7    24.7    23.7    22.7    21.8    20.9    20.1

TAXES:   44.34 percent        -312.0 -1086.2  -212.2   605.5  1117.4  1162.1  1207.7  1257.9  1343.0  1431.5  1523.7  1619.5

PROFIT(After Tax):$(1000)      312.0  1086.2  2527.8  1824.6  1429.4  1484.4  1540.7  1602.7  1708.5  1818.8  1933.6  2053.0

PROFIT PRESENT VALUE           312.0   961.3  1979.6  1264.7   876.7   805.7   740.0   681.2   642.7   605.5   569.6   535.2
(After Tax):$(1000)
CUMULATIVE CASH FLOW         -2760.4 -6282.8 -3755.1 -1930.2  -500.9   983.6  2524.3  4127.0  5835.5  7654.3  9587.9 11640.9
(NPV): $(1000)
(based on profit NPV)        -2760.4 -5877.6 -3898.0 -2633.3 -1756.6  -950.9  -210.9   470.3  1113.0  1718.5  2288.1  2823.3
======================================================================================================================
SIMPLE PAYBACK:       3.5 years             INTERNAL RATE OF RETURN:    23.33%
(Based on 10 Year After-Tax Average)        (Based on 10 Years)
DISCOUNTED PAYBACK:   7.2 years
(Based on 10 Year After-Tax Average)
```

3.2 GROUP 28 - CHEMICALS AND ALLIED PRODUCTS
GROUP 29 - PETROLEUM REFINING AND RELATED INDUSTRIES

a) Background Plant Data

The plant operates a weekly cycle of 7 days of production with no downtime.

The electrical demand was analyzed for a summer month, July 1988, and a winter month, December 1988. The results for the production operation can be generalized as follows:

PRODUCTION PERIOD DATA	DEMAND IN kW	
	SUMMER	WINTER
Maximum Demand Daily Greatest	1,740	1,455
Daily Average Demand	1,353	933

The thermal energy demand requirements can be generalized from steam usage data obtained from the plant.

Summer average steam load: 32,000 lbs/hr

Winter average steam load: 41,000 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.2A** involves the installation of a packaged natural gas fired turbine/generator set. Nominal electrical output is 1,000 kW and a heat recovery steam boiler generates steam at the rate of 8,600 lbs/hr. All electricity is used on-site.
- **Scenario 3.2B** is similar to 3.2A except that a larger turbine/generator and boiler are used. The nominal rating of the system is 1,275 kW and steam is generated at a rate of 11,900 lbs/hr.
- **Scenario 3.2C** is similar to 3.2A except that a larger turbine/generator and boiler are used. The nominal rating of the system is 3,743 kW and steam is generated at a rate of 23,600 lbs/hr. The system operates at full capacity and excess electricity is sold to the Utility.
- **Scenario 3.2D** is similar to 3.2C but with supplemental firing of the heat recovery boiler to increase steam output. The nominal rating of the system is 3,743 kW. Steam output is increased to 37,800 lbs/hr. Excess electricity is sold to the Utility.

- **Scenario 3.2E** is similar to 3.2A but with 8,589 kW generator capacity and steam generating capacity of 42,800 lbs/hr.
- **Scenario 3.2F** involves the installation of a natural gas fired boiler capable of generating 40,000 lbs/hr of steam at 500 psig and 175 degrees of superheat. A single stage back pressure steam turbine would drive a 600 kW generator and exhaust 125 psig steam to the existing plant steam header.
- **Scenario 3.2G** is similar to 3.2F but with a multi-stage steam turbine and a 750 kW generator. The maximum steam capacity of the boiler and the steam conditions are the same as 3.2F.
- **Scenario 3.2H** covers the installation of a 1,100 kW natural gas fired internal combustion engine. The exhaust gases are sufficient to operate a 125 ton absorption chiller.
- **Scenario 3.2I** involves the use of a combined cycle cogeneration system based on a natural gas fired turbine/generator set, a heat recovery steam generator and a steam turbine/generator. The electrical output of the system is 9,519 kW and steam is available at a rate of 30,300 lbs/hr at 125 psig.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2A Prime Mover: Kawasaki CTG 1100 gas turbine

ASSUMPTIONS:
Installed Cost: 1768 $(1000)
Loan Amount: 0 $(1000)
Down Payment 1768 $(1000)
Loan Terms:
  Int. 12.0 %
  Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 1000.0 kW
Gross Heat Rate: 17280.0 Btu/kWh
Usable Heat: 8657.0 Btu/kWh
Load Factors:
  Electrical: 99.0 %
  Thermal: 98.0 %

Elec. Purchase Price: 4.40 cents/kWh
Initial Fuel Cost: 2.83 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			437.9	455.4	473.7	492.6	512.3	532.8	555.7	579.6	604.5	630.5
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			279.4	285.3	292.1	303.9	316.6	328.4	326.7	325.0	323.3	321.6
TOTAL REVENUES: $(1000)			717.4	740.8	765.8	796.5	828.9	861.2	882.4	904.6	927.8	952.2
EXPENSE												
Fuel:			450.8	460.3	471.2	490.2	510.7	529.7	527.0	524.3	521.5	518.8
O&M:			26.0	27.2	28.4	29.7	31.0	32.4	34.0	35.7	37.5	39.4
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			14.1	14.8	15.4	16.1	16.9	17.6	18.5	19.4	20.4	21.4
TOTAL EXPENSES: $(1000)			490.9	502.2	515.0	536.1	558.6	579.8	579.6	579.4	579.5	579.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			226.4	238.5	250.7	260.5	270.3	281.4	302.9	325.2	348.4	372.5
[Depreciation]:(Class 34)	159.1	556.9	636.5	238.7								
[Depreciation]:Class 3(4%)	2.8	7.0	6.7	6.4	6.2	5.9	5.7	5.4	5.2	5.0	4.8	4.6
TAXES: 44.34 percent	-71.8	-250.0	-184.8	-2.9	108.4	112.9	117.3	122.4	132.0	142.0	152.3	163.1
PROFIT(After Tax):$(1000)	71.8	250.0	411.2	241.4	142.3	147.6	153.0	159.1	170.9	183.2	196.0	209.4
PROFIT PRESENT VALUE (After Tax):$(1000)	71.8	221.3	322.0	167.3	87.3	80.1	73.5	67.6	64.3	61.0	57.8	54.6
CUMULATIVE CASH FLOW (NPV): $(1000)	-635.4	-1446.2	-1035.0	-793.5	-651.2	-503.7	-350.7	-191.6	-20.7	162.5	358.5	567.9
(based on profit NPV)	-635.4	-1352.9	-1030.9	-863.5	-776.3	-696.2	-622.7	-555.1	-490.8	-429.8	-372.1	-317.5

SIMPLE PAYBACK: 7.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 14.0 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 6.62%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2B   Prime Mover: Kawasaki CTG 1400 gas turbine

ASSUMPTIONS:

Installed Cost:	1830 $(1000)			Elec. Purchase Price:	4.40 cents/kWh
Loan Amount:	0 $(1000)	Size:	1275.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	1830 $(1000)	Gross Heat Rate:	17875.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	9417.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			558.4	580.7	603.9	628.1	653.2	679.3	708.5	739.0	770.8	803.9
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			387.6	395.7	405.1	421.5	439.1	455.4	453.1	450.7	448.4	446.1
TOTAL REVENUES: $(1000)			945.9	976.4	1009.0	1049.6	1092.3	1134.8	1161.6	1189.8	1219.2	1250.0
EXPENSE												
Fuel:			594.5	607.1	621.4	646.6	673.5	698.6	695.1	691.5	687.9	684.3
O&M:			33.2	34.7	36.2	37.9	39.6	41.3	43.4	45.6	47.9	50.2
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			14.6	15.3	16.0	16.7	17.5	18.2	19.2	20.1	21.1	22.2
TOTAL EXPENSES: $(1000)			642.3	657.0	673.7	701.1	730.5	758.2	757.6	757.2	756.8	756.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			303.6	319.4	335.4	348.4	361.7	376.5	404.0	432.6	462.4	493.3
[Depreciation]:(Class 34)	164.7	576.5	658.8	247.1								
[Depreciation]:Class 3(4%)	2.9	7.2	6.9	6.6	6.4	6.1	5.9	5.6	5.4	5.2	5.0	4.8
TAXES: 44.34 percent	-74.3	-258.8	-160.6	29.1	145.9	151.8	157.8	164.5	176.7	189.5	202.8	216.6
PROFIT(After Tax):$(1000)	74.3	258.8	464.2	290.3	189.5	196.7	203.9	212.1	227.3	243.1	259.6	276.7
PROFIT PRESENT VALUE (After Tax):$(1000)	74.3	229.0	363.5	201.2	116.2	106.7	98.0	90.1	85.5	80.9	76.5	72.1
CUMULATIVE CASH FLOW (NPV): $(1000)	-657.7	-1496.9	-1032.7	-742.5	-553.0	-356.3	-152.4	59.7	287.0	530.1	789.6	1066.3
(based on profit NPV)	-657.7	-1400.3	-1036.8	-835.7	-719.4	-612.7	-514.8	-424.6	-339.1	-258.2	-181.7	-109.6

SIMPLE PAYBACK: 5.8 years   INTERNAL RATE OF RETURN: 11.01%
(Based on 10 Year After-Tax Average)   (Based on 10 Years)
DISCOUNTED PAYBACK: 11.6 years
(Based on 10 Year After-Tax Average)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2C Prime Mover: Solar "Centaur Type H" gas turbine

ASSUMPTIONS:

Installed Cost:	4074 $(1000)			Elec. Purchase Price:	4.40 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	4074 $(1000)	Gross Heat Rate:	12530.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	6347.0 Btu/kWh	Elec. Used On Site:	32.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			524.5	545.5	567.3	590.0	613.6	638.2	665.6	694.2	724.1	755.2
Electricity Sold:			950.7	993.5	1038.2	1085.0	1133.8	1184.8	1244.0	1306.2	1371.6	1440.1
Thermal Use:			766.8	783.0	801.6	833.9	868.7	901.1	896.5	891.9	887.2	882.6
TOTAL REVENUES: $(1000)			2242.1	2322.1	2407.1	2508.9	2616.1	2724.1	2806.2	2892.4	2982.9	3078.0
EXPENSE												
Fuel:			1223.4	1249.2	1278.8	1330.5	1386.0	1437.7	1430.4	1422.9	1415.5	1408.2
O&M:			97.4	101.8	106.3	111.1	116.1	121.4	127.4	133.8	140.5	147.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			32.6	34.1	35.6	37.2	38.9	40.6	42.6	44.8	47.0	49.4
TOTAL EXPENSES: $(1000)			1353.4	1385.1	1420.8	1478.8	1541.0	1599.7	1600.4	1601.5	1603.0	1605.0
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			888.7	937.0	986.4	1030.1	1075.1	1124.4	1205.8	1290.9	1379.9	1472.9
[Depreciation]:(Class 34)	366.7	1283.3	1466.6	550.0								
[Depreciation]:Class 3(4%)	6.5	16.0	15.4	14.8	14.2	13.6	13.1	12.6	12.0	11.6	11.1	10.7
TAXES: 44.34 percent	-165.5	-576.1	-263.1	165.0	431.1	450.7	470.9	493.0	529.3	567.2	606.9	648.4
PROFIT(After Tax):$(1000)	165.5	576.1	1151.8	771.9	555.3	579.4	604.2	631.4	676.5	723.6	773.0	824.6
PROFIT PRESENT VALUE (After Tax):$(1000)	165.5	509.8	902.0	535.0	340.6	314.5	290.2	268.4	254.5	240.9	227.7	215.0
CUMULATIVE CASH FLOW (NPV): $(1000)	-1464.1	-3332.4	-2180.6	-1408.7	-853.4	-274.0	330.2	961.7	1638.1	2361.8	3134.7	3959.3
(based on profit NPV)	-1464.1	-3117.5	-2215.5	-1680.5	-1339.9	-1025.4	-735.2	-466.8	-212.3	28.5	256.3	471.2

SIMPLE PAYBACK: 4.6 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.3 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 16.52%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2D

Prime Mover: Solar "Centaur Type H" gas turbine with supplemental firing

ASSUMPTIONS:

Installed Cost:	4737 $(1000)			Elec. Purchase Price:	4.40 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	4737 $(1000)	Gross Heat Rate:	16275.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	10154.0 Btu/kWh	Elec. Used On Site:	32.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			524.5	545.5	567.3	590.0	613.6	638.2	665.6	694.2	724.1	755.2
Electricity Sold:			950.7	993.5	1038.2	1085.0	1133.8	1184.8	1244.0	1306.2	1371.6	1440.1
Thermal Use:			1226.8	1252.7	1282.3	1334.2	1389.8	1441.6	1434.3	1426.8	1419.4	1412.0
TOTAL REVENUES: $(1000)			2702.1	2791.7	2887.9	3009.1	3137.2	3264.6	3343.9	3427.3	3515.1	3607.4
EXPENSE												
Fuel:			1589.1	1622.6	1661.1	1728.2	1800.2	1867.4	1857.9	1848.2	1838.6	1829.0
O&M:			97.4	101.8	106.3	111.1	116.1	121.4	127.4	133.8	140.5	147.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			37.9	39.6	41.4	43.2	45.2	47.2	49.6	52.1	54.7	57.4
TOTAL EXPENSES: $(1000)			1724.4	1764.0	1808.8	1882.6	1961.6	2036.0	2034.9	2034.1	2033.8	2034.0
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			977.7	1027.7	1079.1	1126.6	1175.6	1228.6	1309.1	1393.2	1481.3	1573.4
[Depreciation]:(Class 34)	426.3	1492.2	1705.3	639.5								
[Depreciation]:Class 3(4%)	7.6	18.6	17.9	17.2	16.5	15.8	15.2	14.6	14.0	13.5	12.9	12.4
TAXES: 44.34 percent	-192.4	-669.9	-330.6	164.5	471.2	492.5	514.5	538.3	574.2	611.8	651.1	692.2
PROFIT(After Tax):$(1000)	192.4	669.9	1308.3	863.2	608.0	634.1	661.1	690.3	734.8	781.4	830.2	881.3
PROFIT PRESENT VALUE (After Tax):$(1000)	192.4	592.8	1024.6	598.2	372.9	344.2	317.5	293.4	276.4	260.1	244.6	229.7
CUMULATIVE CASH FLOW (NPV): $(1000)	-1702.4	-3874.7	-2566.5	-1703.3	-1095.3	-461.2	199.9	890.2	1625.0	2406.5	3236.7	4118.0
(based on profit NPV)	-1702.4	-3624.8	-2600.2	-2002.0	-1629.1	-1285.0	-967.4	-674.0	-397.6	-137.5	107.1	336.9

SIMPLE PAYBACK: 4.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 15.22%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2E   Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:
Installed Cost: 7681 $(1000)
Loan Amount: 0 $(1000)
Down Payment 7681 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 8589.0 kW
Gross Heat Rate: 11165.0 Btu/kWh
Usable Heat: 5011.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.40 cents/kWh
Initial Fuel Cost: 2.83 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 14.00 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			526.6	547.7	569.[illegible]	592.3	616.0	640.7	668.2	697.0	726.9	758.2
Electricity Sold:			2759.2	2883.3	3013.1	3148.7	3290.4	3438.4	3610.3	3790.9	3980.4	4179.4
Thermal Use:			1389.2	1418.5	1452.2	1510.8	1573.8	1632.5	1624.2	1615.8	1607.4	1599.0
TOTAL REVENUES: $(1000)			4675.0	4849.5	5034.8	5251.8	5480.2	5711.6	5902.8	6103.6	6314.7	6536.6
EXPENSE												
Fuel:			2501.5	2554.3	2614.9	2720.5	2834.0	2939.7	2924.7	2909.5	2894.3	2879.3
O&M:			223.5	233.5	244.0	255.0	266.5	278.5	292.4	307.0	322.4	338.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2786.5	2852.1	2926.0	3045.6	3173.7	3294.7	3297.5	3300.9	3305.3	3310.8
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1888.5	1997.5	2108.8	2206.2	2306.5	2416.9	2605.3	2802.7	3009.4	3225.8
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-401.6	413.5	923.2	966.8	1011.8	1061.2	1145.1	1233.0	1325.1	1421.4
PROFIT(After Tax):$(1000)	312.0	1086.2	2290.1	1583.9	1185.6	1239.4	1294.7	1355.8	1460.2	1569.6	1684.3	1804.4
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	17[illegible]3.5	1097.7	727.2	672.7	621.9	576.3	549.3	522.5	496.2	470.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-3992.7	-2408.8	-1223.2	16.2	1310.9	2666.7	4126.9	5696.5	7380.8	9185.2
(based on profit NPV)	-2760.4	-5877.6	-4084.1	-2986.4	-2259.2	-1586.5	-964.6	-388.4	160.9	683.4	1179.6	1650.0

SIMPLE PAYBACK: 4.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.3 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.27%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.2F   Prime Mover: Coppus RLHA24 steam turbine
with new boiler

ASSUMPTIONS:

Installed Cost:	1201 $(1000)			Elec. Purchase Price:	4.40 cents/kWh
Loan Amount:	0 $(1000)	Size:	600.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	1201 $(1000)	Gross Heat Rate:	68700.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	60780.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.10 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			262.8	273.3	284.2	295.6	307.4	319.7	333.4	347.8	362.7	378.3
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			1177.1	1202.0	1230.4	1280.2	1333.5	1383.3	1376.2	1369.1	1361.9	1354.9
TOTAL REVENUES: $(1000)			1439.9	1475.2	1514.6	1575.7	1640.9	1703.0	1709.7	1716.8	1724.7	1733.2
EXPENSE												
Fuel:			1344.1	1372.4	1405.0	1461.7	1522.7	1579.5	1571.4	1563.3	1555.1	1547.0
O&M:			5.2	5.4	5.7	5.9	6.2	6.5	6.8	7.1	7.5	7.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			9.6	10.0	10.5	11.0	11.5	12.0	12.6	13.2	13.9	14.6
TOTAL EXPENSES: $(1000)			1358.9	1387.9	1421.1	1478.6	1540.3	1597.9	1590.8	1583.6	1576.5	1569.5
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			81.0	87.3	93.5	97.1	100.6	105.0	118.8	133.2	148.2	163.7
[Depreciation]:(Class 34)	108.1	378.3	432.4	162.1								
[Depreciation]:Class 3(4%)	1.9	4.7	4.5	4.4	4.2	4.0	3.9	3.7	3.6	3.4	3.3	3.1
TAXES: 44.34 percent	-48.8	-169.8	-157.8	-35.1	39.6	41.3	42.9	44.9	51.1	57.6	64.3	71.2
PROFIT(After Tax):$(1000)	48.8	169.8	238.8	122.4	53.9	55.8	57.7	60.1	67.7	75.7	83.9	92.5
PROFIT PRESENT VALUE (After Tax):$(1000)	48.8	150.3	187.0	84.8	33.1	30.3	27.7	25.5	25.5	25.2	24.7	24.1
CUMULATIVE CASH FLOW (NPV): $(1000)	-431.6	-982.4	-743.6	-621.2	-567.3	-511.5	-453.8	-393.7	-325.9	-250.3	-166.3	-73.8
(based on profit NPV)	-431.6	-919.0	-732.0	-647.2	-614.1	-583.8	-556.1	-530.6	-505.1	-479.9	-455.2	-431.0

SIMPLE PAYBACK: 10.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 20.1 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: -1.48%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO. MBEL-3.2G

Prime Mover: Dresser Rand steam turbine with new boiler

ASSUMPTIONS:

Installed Cost: 1189 $(1000)
Loan Amount: 0 $(1000)
Down Payment 1189 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 750.0 kW
Gross Heat Rate: 55004.0 Btu/kWh
Usable Heat: 48877.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.40 cents/kWh
Initial Fuel Cost: 2.83 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.10 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			328.4	341.6	355.2	369.5	384.2	399.6	416.8	434.7	453.4	472.9
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			1183.2	1208.2	1236.8	1286.8	1340.5	1390.5	1383.4	1376.2	1369.0	1361.9
TOTAL REVENUES: $(1000)			1511.7	1549.8	1592.1	1656.3	1724.7	1790.1	1800.2	1810.9	1822.4	1834.8
EXPENSE												
Fuel:			1345.2	1373.5	1406.1	1462.9	1523.9	1580.7	1572.7	1564.5	1556.4	1548.3
O&M:			6.5	6.8	7.1	7.4	7.8	8.1	8.5	8.9	9.4	9.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			9.5	9.9	10.4	10.9	11.3	11.9	12.4	13.1	13.7	14.4
TOTAL EXPENSES: $(1000)			1361.2	1390.3	1423.6	1481.2	1543.0	1600.7	1593.6	1586.5	1579.5	1572.5
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			150.5	159.5	168.5	175.1	181.7	189.4	206.5	224.4	243.0	262.3
[Depreciation]:(Class 34)	107.0	374.5	428.0	160.5								
[Depreciation]:Class 3(4%)	1.9	4.7	4.5	4.3	4.1	4.0	3.8	3.7	3.5	3.4	3.2	3.1
TAXES: 44.34 percent	-48.3	-168.1	-125.0	-2.4	72.9	75.9	78.9	82.3	90.0	98.0	106.3	114.9
PROFIT(After Tax):$(1000)	48.3	168.1	275.6	161.9	95.6	99.2	102.8	107.0	116.5	126.4	136.7	147.4
PROFIT PRESENT VALUE (After Tax):$(1000)	48.3	148.8	215.8	112.2	58.7	53.9	49.4	45.5	43.8	42.1	40.3	38.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-427.3	-972.6	-697.0	-535.1	-439.5	-340.3	-237.4	-130.4	-13.9	112.5	249.2	396.5
(based on profit NPV)	-427.3	-909.8	-694.0	-581.8	-523.2	-469.3	-419.9	-374.5	-330.6	-288.5	-248.3	-209.9

SIMPLE PAYBACK: 7.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 13.9 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 6.79%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.2H

Prime Mover: Waukesha 9500 GSI with
125 ton absorption chiller

ASSUMPTIONS:

Installed Cost:	1500 $(1000)			Elec. Purchase Price:	4.40 cents/kWh
Loan Amount:	0 $(1000)	Size:	1100.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	1500 $(1000)	Gross Heat Rate:	10918.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Abs. Chill Rate:	0.1 Ton/kW	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Chiller:	98.0 %	O&M Charge:	0.80 cents/kWh
IRR Guess:	20.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			481.7	501.0	521.0	541.9	563.5	586.1	611.3	637.6	665.0	693.6
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			45.7	46.7	47.8	49.7	51.8	53.7	53.4	53.2	52.9	52.6
TOTAL REVENUES: $(1000)			527.4	547.7	568.8	591.6	615.3	639.8	664.7	690.7	717.9	746.2
EXPENSES												
Fuel:			313.3	319.9	327.5	340.7	354.9	368.2	366.3	364.4	362.5	360.6
O&M:			76.3	79.8	83.3	87.1	91.0	95.1	99.9	104.9	110.1	115.6
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			12.0	12.5	13.1	13.7	14.3	15.0	15.7	16.5	17.3	18.2
TOTAL EXPENSES: $(1000)			401.6	412.2	423.9	441.5	460.2	478.2	481.8	485.7	489.9	494.4
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	125.8	135.5	144.9	150.1	155.1	161.6	182.9	205.0	228.0	251.8
[Depreciation]: (Class 34)	135.0	472.5	540.0	202.5								
[Depreciation]: (Class 3, @ 4%)	2.4	5.9	5.7	5.4	5.2	5.0	4.8	4.6	4.4	4.3	4.1	3.9
TAXES: 44.34 percent	-60.9	-212.1	-186.2	-32.1	61.9	64.3	66.6	69.6	79.1	89.0	99.3	109.9
PROFIT(After Tax):$(1000)	60.9	212.1	312.0	167.6	83.0	85.8	88.5	92.0	103.8	116.0	128.7	141.9
PROFIT PRESENT VALUE (After Tax):$(1000)	60.9	187.7	244.3	116.2	50.9	46.5	42.5	39.1	39.0	38.6	37.9	37.0
CUMULATIVE CASH FLOW (NPV): $(1000)	-539.1	-1227.0	-915.0	-747.4	-664.4	-578.6	-490.2	-398.2	-294.4	-178.4	-49.7	92.2
(based on profit NPV)	-539.1	-1147.8	-903.5	-787.3	-736.4	-689.9	-647.4	-608.3	-569.3	-530.7	-492.7	-455.8

SIMPLE PAYBACK: 9.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 17.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 1.38%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.2I

Prime Mover: Solar Mars gas tubine/steam turbine combined cycle

ASSUMPTIONS:

Installed Cost:	8200 $(1000)
Loan Amount:	0 $(1000)
Down Payment	8200 $(1000)
Loan Terms:	
Int.	12.0 %
Term	6.0 Years
Discount Rate:	13.0%
IRR Guess:	20.0%

Size:	9519.0 kW
Gross Heat Rate:	10075.0 Btu/kWh
Usable Heat:	3199.0 Btu/kWh
Load Factors:	
Electrical:	99.0 %
Thermal:	98.0 %

Elec. Purchase Price:	4.40 cents/kWh
Initial Fuel Cost:	2.83 $/MMBtu
Boiler Efficiency:	80.00 %
Elec. Used On Site:	12.60 %
Electricity Sale Price:	3.76 cents/kWh
Construction Period:	2.00 year(s)
O&M Charge:	0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			525.3	546.3	568.1	590.8	614.5	639.0	666.5	695.2	725.1	756.3
Electricity Sold:			3107.7	3247.5	3393.7	3546.4	3706.0	3872.8	4066.4	4269.7	4483.2	4707.4
Thermal Use:			982.9	1003.7	1027.4	1068.9	1113.5	1155.1	1149.2	1143.2	1137.2	1131.3
TOTAL REVENUES: $(1000)			4615.9	4797.5	4989.2	5206.2	5434.0	5666.9	5882.1	6108.1	6345.5	6595.0
EXPENSES												
Fuel:			2501.8	2554.5	2615.1	2720.7	2834.2	2939.9	2924.9	2909.7	2894.6	2879.5
O&M:			247.7	258.8	270.4	282.6	295.3	308.6	324.1	340.3	357.3	375.1
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			65.6	68.6	71.6	74.9	78.2	81.7	85.8	90.1	94.6	99.4
TOTAL EXPENSES: $(1000)			2815.0	2881.9	2957.2	3078.2	3207.7	3330.3	3334.8	3340.1	3346.5	3354.0
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	1800.9	1915.6	2032.1	2128.0	2226.2	2336.6	2547.3	2768.0	2999.1	3240.9
[Depreciation]: (Class 34)	738.0	2583.0	2952.0	1107.0								
[Depreciation]: (Class 3, @ 4%)	13.1	32.3	31.0	29.7	28.6	27.4	26.3	25.3	24.3	23.3	22.4	21.5
TAXES: 44.34 percent	-333.0	-1159.6	-524.2	345.3	888.4	931.4	975.4	1024.8	1118.7	1217.0	1319.9	1427.5
PROFIT(After Tax):$(1000)	333.0	1159.6	2325.0	1570.2	1143.7	1196.6	1250.8	1311.7	1428.6	1551.0	1679.2	1813.4
PROFIT PRESENT VALUE (After Tax):$(1000)	333.0	1026.2	1820.8	1088.3	701.5	649.5	600.8	557.6	537.4	516.3	494.7	472.8
CUMULATIVE CASH FLOW (NPV): $(1000)	-2947.0	-6707.3	-4382.3	-2812.1	-1668.4	-471.8	779.0	2090.7	3519.3	5070.3	6749.5	8562.9
(based on profit NPV)	-2947.0	-6274.7	-4453.9	-3365.7	-2664.2	-2014.7	-1414.0	-856.4	-319.0	197.3	692.0	1164.7

SIMPLE PAYBACK: 4.4 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.0 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 17.23%
(Based on 10 Years)

3.3 GROUP 20 - FOOD AND KINDRED PRODUCTS

a) Background Plant Data

The plant operates a weekly cycle of 5 days of 24 hours per day production and 2 downtime days. There are 3 shutdown weeks annually for maintenance and implementing production changes.

The total connected plant load is 4000 kVa. Steam from a cogeneration system would be supplied at 100 psig, dry and saturated.

The electrical demand was analyzed for summer and winter months. The results for the production operation can be generalized as follows:

PRODUCTION PERIOD DATA	**DEMAND IN kW**	
	SUMMER	**WINTER**
Maximum Demand Daily Greatest	2,840	2,920
Daily Average Demand	1,970	1,120

Summer average steam load: 9,100 lbs/hr

Winter average steam load: 22,100 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.3A** involves the use of a packaged natural gas fired turbine/generator cogeneration system with a heat recovery boiler. The nominal rating of the system is 800 kW, and usable heat is produced in steam form equal to 6,500 lbs/hr at 100 psig.
- **Scenario 3.3B** is similar to 3.3A except that a larger turbine/generator and boiler are used. The nominal rating of the system is 1,275 kW and 100 psig steam is produced at a rate of 12,000 lbs/hr.
- **Scenario 3.3C** is similar to 3.3A except that a larger turbine/generator and boiler are used. The nominal rating of the system is 1,920 kW and 100 psig steam is produced at a rate of 17,600 lbs/hr.
- **Scenario 3.3D** involves the use of a back pressure steam turbine with a boiler capable of burning process waste. Steam would be generated at 500 psig and 680°F and exhausted from the turbine to the plant header at 100 psig. The

nominal rating of the system is 370 kW, and usable heat in the form of steam is produced at a rate of 16,000 lbs/hr.

- **Scenario 3.3E** is a combined cycle cogeneration system based on a packaged natural gas fired turbine/generator, heat recovery boiler, and back pressure steam turbine. Superheated steam at 900 psig from the heat recovery boiler passes through the steam turbine driving a second generator before exhausting to the plant header at 100 psig. The nominal rating of the combined system is 4,382 kW and steam is available at a rate of 27,800 lbs/hr.

- **Scenario 3.3F** is similar to 3.3E except that a smaller turbine/generator, boiler, and steam turbine are used. The nominal rating of the system is 2,458 kW and steam is available at a rate of 13,700 lbs/hr.

- **Scenario 3.3G** involves the use of a packaged natural gas fired internal combustion engine/generator. Heat is recovered from the engine cooling water and exhaust and is used to generate 100 psig steam at a rate of 2,000 lbs/hr. The nominal rating of the system is 550 kW.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" Sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.3A Prime Mover: Solar "Saturn" Gas Turbine

ASSUMPTIONS:					
Installed Cost:	1618 $(1000)			Elec. Purchase Price:	4.31 cents/kWh
Loan Amount:	0 $(1000)	Size:	800.0 kW	Initial Fuel Cost:	3.44 $/MMBtu
Down Payment	1618 $(1000)	Gross Heat Rate:	16125.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	8091.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	96.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			343.2	356.9	371.2	386.0	401.5	417.5	435.5	454.2	473.7	494.1
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			248.8	254.0	260.1	270.6	281.8	292.4	290.9	289.3	287.8	286.3
TOTAL REVENUES: $(1000)			592.0	610.9	631.2	656.6	683.3	709.9	726.3	743.6	761.6	780.5
EXPENSE												
Fuel:			409.0	417.7	427.6	444.8	463.4	480.7	478.2	475.7	473.3	470.8
O&M:			20.8	21.8	22.7	23.8	24.8	25.9	27.2	28.6	30.0	31.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			12.9	13.5	14.1	14.8	15.4	16.1	16.9	17.8	18.7	19.6
TOTAL EXPENSES: $(1000)			442.8	453.0	464.4	483.4	503.7	522.8	522.4	522.1	522.0	521.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			149.2	158.0	166.8	173.2	179.7	187.1	203.9	221.4	239.6	258.5
[Depreciation]:(Class 34)	145.6	509.7	582.5	218.4								
[Depreciation]:Class 3(4%)	2.6	6.4	6.1	5.9	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.2
TAXES: 44.34 percent	-65.7	-228.8	-194.8	-29.4	71.5	74.4	77.4	80.8	88.3	96.1	104.3	112.7
PROFIT(After Tax):$(1000)	65.7	228.8	344.0	187.4	95.3	98.8	102.3	106.4	115.6	125.3	135.3	145.8
PROFIT PRESENT VALUE (After Tax):$(1000)	65.7	202.5	269.4	129.9	58.5	53.6	49.1	45.2	43.5	41.7	39.9	38.0
CUMULATIVE CASE FLOW (NPV). $(1000)	-581.5	-1323.5	-979.5	-792.1	-696.7	-597.9	-495.6	-389.3	-273.6	-148.3	-13.0	132.7
(based on profit NPV)	-581.5	-1238.1	-968.7	-838.8	-780.4	-726.7	-677.6	-632.4	-588.9	-547.2	-507.3	-469.3

SIMPLE PAYBACK: 9.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 17.2 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 1.86%
(Based on 10 Years)

```
                         COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.3B        Prime Mover:      Kawasaki CTG 1400 gas turbine

ASSUMPTIONS:
Installed Cost: 1830 $(1000)                                  Elec. Purchase Price:        4.31 cents/kWh
Loan Amount:       0 $(1000)   Size:             1275.0 kW    Initial Fuel Cost:           3.44 $/MMBtu
Down Payment    1830 $(1000)   Gross Heat Rate: 17875.0 Btu/kWh  Boiler Efficiency:       80.00 %
Loan Terms:                    Usable Heat:      9417.0 Btu/kWh  Elec. Used On Site:     100.00 %
      Int.      12.0 %         Load Factors:                  Electricity Sale Price:      0.00 cents/kWh
      Term       6.0 Years        Electrical:       83.0 %    Construction Period:         2.00 year(s)
Discount Rate:  13.0%             Thermal:          82.0 %    O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
==========================================================================================================

YEAR:                        1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE
      Displaced Electricity:                 458.5   476.9   496.0   515.8   536.4   557.9   581.9   606.9   633.0   660.2
      Electricity Sold:                        0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
      Thermal Use:                           394.2   402.5   412.0   428.7   446.6   463.2   460.8   458.5   456.1   453.7
TOTAL REVENUES: $(1000)                      852.7   879.4   908.0   944.5   983.0  1021.1  1042.7  1065.4  1089.1  1113.9

EXPENSE
      Fuel:                                  605.9   618.7   633.3   658.9   686.4   712.0   708.3   704.7   701.0   697.4
      O&M:                                    27.8    29.1    30.4    31.7    33.2    34.7    36.4    38.2    40.1    42.1
      P&I:                                     0.0     0.0     0.0     0.0     0.0     0.0
      Insurance:                              14.6    15.3    16.0    16.7    17.5    18.2    19.2    20.1    21.1    22.2
TOTAL EXPENSES: $(1000)                      646.3   663.0   679.7   707.3   737.0   764.9   763.9   763.0   762.2   761.7

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                     204.4   216.4   228.3   237.1   246.0   256.2   278.8   302.4   326.8   352.3

[Depreciation]:(Class 34)    164.7   576.5   658.8   247.1

[Depreciation]:Class 3(4%)     2.9     7.2     6.9     6.6     6.4     6.1     5.9     5.6     5.4     5.2     5.0     4.8

TAXES:   44.34 percent       -74.3  -258.8  -204.5   -16.5    98.4   102.4   106.5   111.1   121.2   131.8   142.7   154.1

PROFIT(After Tax):$(1000)     74.3   258.8   408.9   232.9   129.9   134.7   139.5   145.1   157.6   170.6   184.1   198.2

PROFIT PRESENT VALUE          74.3   229.0   320.3   161.4    79.7    73.1    67.0    61.7    59.3    56.8    54.2    51.7
(After Tax):$(1000)
CUMULATIVE CASH FLOW        -657.7 -1496.9 -1087.9  -855.0  -725.1  -590.4  -450.9  -305.8  -148.2    22.4   206.6   404.7
(NPV): $(1000)
(based on profit NPV)       -657.7 -1400.3 -1080.1  -918.6  -839.0  -765.9  -698.8  -637.2  -577.9  -521.1  -466.8  -415.2
==========================================================================================================
SIMPLE PAYBACK:        7.9 years                INTERNAL RATE OF RETURN:     4.71%
(Based on 10 Year After-Tax Average)            (Based on 10 Years)
DISCOUNTED PAYBACK:  15.2 years
(Based on 10 Year After-Tax Average)
```

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.3C Prime Mover: Kawasaki CTG 2200 gas turbine

ASSUMPTIONS:
Installed Cost: 3044 $(1000)
Loan Amount: 0 $(1000)
Down Payment 3044 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 1920.0 kW
Gross Heat Rate: 17771.0 Btu/kWh
Usable Heat: 9197.0 Btu/kWh
Load Factors:
Electrical: 84.0 %
Thermal: 82.0 %

Elec. Purchase Price: 4.31 cents/kWh
Initial Fuel Cost: 3.44 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			698.8	726.8	755.9	786.1	817.5	850.2	886.8	924.9	964.7	1006.2
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			579.7	591.9	606.0	630.5	656.7	681.2	677.8	674.2	670.7	667.3
TOTAL REVENUES: $(1000)			1278.6	1318.7	1361.8	1416.6	1474.3	1531.5	1564.6	1599.2	1635.4	1673.4
EXPENSE												
Fuel:			918.0	937.4	959.6	998.3	1040.0	1078.8	1073.3	1067.7	1062.1	1056.6
O&M:			42.4	44.3	46.3	48.4	50.5	52.8	55.5	58.2	61.1	64.2
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			24.4	25.4	26.6	27.8	29.0	30.3	31.9	33.5	35.1	36.9
TOTAL EXPENSES: $(1000)			984.7	1007.1	1032.5	1074.5	1119.6	1161.9	1160.6	1159.4	1158.4	1157.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			293.8	311.6	329.4	342.1	354.7	369.6	404.0	439.8	477.0	515.8
[Depreciation]:(Class 34)	274.0	958.9	1095.8	410.9								
[Depreciation]:Class 3(4%)	4.9	12.0	11.5	11.0	10.6	10.2	9.8	9.4	9.0	8.6	8.3	8.0
TAXES: 44.34 percent	-123.6	-430.5	-360.7	-48.9	141.4	147.2	153.0	159.7	175.1	191.2	207.8	225.2
PROFIT(After Tax):$(1000)	123.6	430.5	654.5	360.6	188.0	194.9	201.8	209.9	228.9	248.6	269.2	290.6
PROFIT PRESENT VALUE (After Tax):$(1000)	123.6	380.9	512.6	249.9	115.3	105.8	96.9	89.2	86.1	82.8	79.3	75.8
CUMULATIVE CASH FLOW (NPV): $(1000)	-1094.0	-2489.9	-1835.4	-1474.8	-1286.8	-1091.8	-890.1	-680.2	-451.4	-202.7	66.5	357.1
(based on profit NPV)	-1094.0	-2329.3	-1816.7	-1566.8	-1451.5	-1345.7	-1248.8	-1159.6	-1073.5	-990.7	-911.4	-835.7

SIMPLE PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 16.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 2.61%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.3D

Prime Mover: Steam turbine, boiler burns plant waste

ASSUMPTIONS:

Installed Cost: 1302 $(1000)
Loan Amount: 0 $(1000)
Down Payment 1302 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 20.0%

Size: 370.0 kW
Gross Heat Rate: 49977.0 Btu/kWh
Usable Heat: 43403.0 Btu/kWh
Load Factors:
Electrical: 98.0 %
Thermal: 85.0 %

Elec. Purchase Price: 4.31 cents/kWh
Initial Fuel Cost: 0.19 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.10 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			157.1	163.4	169.9	176.7	183.8	191.2	199.4	207.9	216.9	226.2
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			30.2	30.8	31.6	32.8	34.2	35.5	35.3	35.1	34.9	34.7
TOTAL REVENUES: $(1000)			187.3	194.2	201.5	209.6	218.0	226.6	234.7	243.1	251.8	261.0
EXPENSES												
Fuel:			40.1	40.9	41.9	43.6	45.4	47.1	46.9	46.6	46.4	46.1
O&M:			3.2	3.3	3.5	3.6	3.8	4.0	4.2	4.4	4.6	4.8
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			10.4	10.9	11.4	11.9	12.4	13.0	13.6	14.3	15.0	15.8
TOTAL EXPENSES: $(1000)			53.7	55.1	56.7	59.1	61.6	64.0	64.6	65.3	66.0	66.7
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	133.6	139.1	144.8	150.5	156.4	162.6	170.0	177.8	185.8	194.2
[Depreciation]: (Class 34)	117.2	410.1	468.7	175.8								
[Depreciation]: (Class 3, @ 4%)	2.1	5.1	4.9	4.7	4.5	4.4	4.2	4.0	3.9	3.7	3.5	3.4
TAXES: 44.34 percent	-52.9	-184.1	-150.8	-18.4	62.2	64.8	67.5	70.3	73.7	77.2	80.8	84.6
PROFIT(After Tax):$(1000)	52.9	184.1	284.4	157.5	82.6	85.7	88.9	92.3	96.3	100.6	105.0	109.6
PROFIT PRESENT VALUE (After Tax):$(1000)	52.9	162.9	222.7	109.1	50.6	46.5	42.7	39.2	36.2	33.5	30.9	28.6
CUMULATIVE CASH FLOW (NPV): $(1000)	-467.9	-1065.0	-780.6	-623.1	-540.6	-454.9	-366.0	-273.7	-177.4	-76.8	28.3	137.9
(based on profit NPV)	-467.9	-996.3	-773.6	-664.5	-613.8	-567.3	-524.6	-485.4	-449.1	-415.7	-384.7	-356.1

SIMPLE PAYBACK: 8.9 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 16.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 2.43%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

```
PLANT CODE NO..:MBEL-3.3E          Prime Mover:    Combined cycle, gas/steam
                                   turbine, Centaur H/Coppus RLHA 24
ASSUMPTIONS:
Installed Cost:    4274 $(1000)                                     Elec. Purchase Price:       4.31 cents/kWh
Loan Amount:          0 $(1000)    Size:             4382.0 kW      Initial Fuel Cost:          3.44 $/MMBtu
Down Payment       4274 $(1000)    Gross Heat Rate: 12530.0 Btu/kWh Boiler Efficiency:         80.00 %
Loan Terms:                        Usable Heat:      6347.0 Btu/kWh Elec. Used On Site:        38.00 %
      Int.         12.0 %          Load Factors:                    Electricity Sale Price:     3.76 cents/kWh
      Term          6.0 Years         Electrical:      99.0 %       Construction Period:        2.00 year(s)
Discount Rate:     13.0%              Thermal:         67.0 %       O&M Charge:                 0.30 cents/kWh
IRR Guess:         20.0%
==================================================================================================================

YEAR:                             1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE:
      Displaced Electricity:                      714.3   742.9   772.6   803.5   835.6   869.1   906.4   945.4   986.1  1028.5
      Electricity Sold:                          1014.8  1060.5  1108.2  1158.1  1210.2  1264.7  1327.9  1394.3  1464.0  1537.2
      Thermal Use:                                746.1   761.8   779.9   811.4   845.2   876.7   872.2   867.7   863.2   858.7
TOTAL REVENUES: $(1000)                          2475.2  2565.2  2660.7  2773.0  2891.1  3010.5  3106.6  3207.4  3313.3  3424.4

EXPENSES
      Fuel:                                      1741.0  1777.8  1819.9  1893.4  1972.4  2045.9  2035.5  2024.9  2014.4  2003.9
      O&M:                                        114.0   119.1   124.5   130.1   136.0   142.1   149.2   156.6   164.5   172.7
      P&I:                                          0.0     0.0     0.0     0.0     0.0     0.0
      Insurance:                                   34.2    35.7    37.3    39.0    40.8    42.6    44.7    47.0    49.3    51.8
TOTAL EXPENSES: $(1000)                          1889.2  1932.6  1981.7  2062.5  2149.1  2230.6  2229.4  2228.5  2228.2  2228.4

TAX INCENTIVES:

PROFIT (Pre Tax)$(1000)            0.0     0.0    586.0   632.6   679.0   710.4   742.0   779.8   877.2   978.9  1085.1  1196.0

[Depreciation]: (Class 34)       384.7  1346.3   1538.6   577.0

[Depreciation]: (Class 3, @ 4%)    6.8    16.8     16.1    15.5    14.9    14.3    13.7    13.2    12.6    12.1    11.7    11.2

TAXES:    44.34 percent         -173.6  -604.4   -429.6    17.8   294.5   308.7   322.9   339.9   383.3   426.7   476.0   525.4

PROFIT(After Tax):$(1000)        173.6   604.4   1015.6   614.8   384.5   401.8   419.1   439.9   493.8   550.2   609.1   670.7

PROFIT PRESENT VALUE             173.6   534.9    795.3   426.1   235.8   218.1   201.3   187.0   185.8   183.2   179.4   174.8
(After Tax):$(1000)
CUMULATIVE CASH FLOW           -1536.0 -3496.0  -2480.4 -1865.6 -1481.1 -1079.4  -660.3  -220.4   273.4   823.7  1432.8  2103.5
(NPV): $(1000)
(based on profit NPV)          -1536.0 -3270.5  -2475.2 -2049.1 -1813.3 -1595.2 -1393.9 -1206.9 -1021.2  -838.0  -658.6  -483.7
==================================================================================================================
SIMPLE PAYBACK:              6.2 years      INTERNAL RATE OF RETURN:    9.25%
(Based on 10 Year After-Tax Average)        (Based on 10 Years)
DISCOUNTED PAYBACK:         12.5 years
(Based on 10 Year After-Tax Average)
```

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.3F

Prime Mover: Combined cycle, gas/steam turbine, CTG 2200/Coppus RLHA 24

ASSUMPTIONS:

Installed Cost:	2590 $(1000)			Elec. Purchase Price:	4.31 cents/kWh
Loan Amount:	0 $(1000)	Size:	2458.0 kW	Initial Fuel Cost:	3.44 $/MMBtu
Down Payment	2590 $(1000)	Gross Heat Rate:	13883.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	5583.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	97.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	96.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	20.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			1033.1	1074.4	1117.4	1162.1	1208.6	1256.9	1311.0	1367.4	1426.2	1487.5
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			527.4	538.6	551.3	573.6	597.5	619.8	616.7	613.4	610.3	607.1
TOTAL REVENUES: $(1000)			1560.6	1613.0	1668.8	1735.7	1806.1	1876.8	1927.6	1980.8	2036.4	2094.6
EXPENSES												
Fuel:			1060.2	1082.6	1108.2	1153.0	1201.1	1245.9	1239.5	1233.1	1226.7	1220.3
O&M:			62.7	65.5	68.4	71.5	74.7	78.1	82.0	86.1	90.4	94.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			20.7	21.7	22.6	23.6	24.7	25.8	27.1	28.5	29.9	31.4
TOTAL EXPENSES: $(1000)			1143.6	1169.7	1199.3	1248.1	1300.5	1349.8	1348.6	1347.6	1346.9	1346.6
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	417.0	443.3	469.5	487.6	505.6	527.0	579.0	633.2	689.5	748.0
[Depreciation]: (Class 34)	233.1	815.9	932.4	349.7								
[Depreciation]: (Class 3, @ 4%)	4.1	10.2	9.8	9.4	9.0	8.7	8.3	8.0	7.7	7.4	7.1	6.8
TAXES: 44.34 percent	-105.2	-366.3	-232.9	37.4	204.2	212.4	220.5	230.1	253.3	277.5	302.6	328.7
PROFIT(After Tax):$(1000)	105.2	366.3	649.9	406.0	265.3	275.2	285.1	296.9	325.7	355.7	386.9	419.3
PROFIT PRESENT VALUE (After Tax):$(1000)	105.2	324.1	508.9	281.3	162.7	149.4	136.9	126.2	122.5	118.4	114.0	109.3
CUMULATIVE CASH FLOW (NPV): $(1000)	-930.8	-2118.5	-1468.7	-1062.7	-797.4	-522.2	-237.0	59.8	385.5	741.2	1128.1	1547.4
(based on profit NPV)	-930.8	-1981.9	-1473.0	-1191.6	-1028.9	-879.5	-742.5	-616.4	-493.9	-375.4	-261.5	-152.2

SIMPLE PAYBACK: 5.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 11.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 11.08%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.3G

Prime Mover: Waukesha 3600 GSI Gas Engine

ASSUMPTIONS:

Installed Cost: 830 $(1000)
Loan Amount: 0 $(1000)
Down Payment 830 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 20.0%

Size: 550.0 kW
Gross Heat Rate: 11265.0 Btu/kWh
Usable Heat: 3636.0 Btu/kWh
Load Factors:
Electrical: 95.0 %
Thermal: 94.0 %

Elec. Purchase Price: 4.31 cents/kWh
Initial Fuel Cost: 3.44 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.80 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			226.4	235.5	244.9	254.7	264.9	275.5	287.3	299.7	312.5	326.0
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			75.3	76.8	78.7	81.8	85.3	88.4	88.0	87.5	87.1	86.6
TOTAL REVENUES: $(1000)			301.7	312.3	323.5	336.5	350.1	363.9	375.3	387.2	399.6	412.6
EXPENSES												
Fuel:			188.5	192.5	197.1	205.0	213.6	221.5	220.4	219.3	218.1	217.0
O&M:			36.6	38.3	40.0	41.8	43.7	45.6	47.9	50.3	52.8	55.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			6.6	6.9	7.3	7.6	7.9	8.3	8.7	9.1	9.6	10.1
TOTAL EXPENSES: $(1000)			231.8	237.7	244.3	254.4	265.2	275.4	277.0	278.7	280.5	282.5
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	69.9	74.6	79.2	82.1	85.0	88.5	98.3	108.5	119.1	130.1
[Depreciation]: (Class 34)	74.7	261.5	298.8	112.1								
[Depreciation]: (Class 3, @ 4%)	1.3	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2
TAXES: 44.34 percent	-33.7	-117.4	-102.9	-17.9	33.9	35.2	36.5	38.1	42.5	47.1	51.8	56.7
PROFIT(After Tax):$(1000)	33.7	117.4	172.8	92.5	45.4	46.9	48.5	50.4	55.8	61.4	67.3	73.4
PROFIT PRESENT VALUE (After Tax):$(1000)	33.7	103.9	135.3	64.1	27.8	25.5	23.3	21.4	21.0	20.4	19.8	19.1
CUMULATIVE CASH FLOW (NPV): $(1000)	-298.3	-678.9	-506.1	-413.6	-368.2	-321.3	-272.8	-222.4	-166.6	-105.2	-37.9	35.5
(based on profit NPV)	-298.3	-635.1	-499.8	-435.7	-407.8	-382.4	-359.1	-337.7	-316.7	-296.2	-276.4	-257.3

SIMPLE PAYBACK: 9.5 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 18.0 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 0.98%
(Based on 10 Years)

3.4 GROUP 28 - CHEMICALS AND ALLIED PRODUCTS

a) Background Plant Data

The plant operates a weekly cycle of 5 days of production.

The electrical demand was analyzed for summer and winter months. The results for the production operation can be generalized as follows:

PRODUCTION PERIOD DATA	DEMAND IN kVA SUMMER	DEMAND IN kVA WINTER
Maximum Demand Daily Greatest	3,900	2,800
Maximum Demand Daily Smallest	3,500	2,600
Minimum Demand Daily Greatest	3,000	2,000
Minimum Demand Daily Smallest	2,600	-

Summer average steam load: 10,000 lbs/hr

Winter average steam load: 38,000 lbs/hr

There are several cogeneration system configurations which could be considered. These are described in the following section.

b) Cogeneration Scenarios

- **Scenario 3.4A** involves the installation of a packaged natural gas fired, gas turbine/generator set. Nominal electrical output is 1,920 kW. A heat recovery steam boiler generates steam at a rate of 17,500 lbs/hr. The turbine does not operate at full capacity and all electricity is used on-site.
- **Scenario 3.4B** involves the installation of a packaged natural gas fired, gas turbine/generator set. Nominal electrical output is 2,485 kW and a heat recovery steam boiler generates steam at a rate of 24,200 lbs/hr. The turbine does not operate at full capacity and all electricity is used on-site.
- **Scenario 3.4C** involves the installation of a packaged natural gas fired, gas turbine/generator set. Nominal electrical

output is 3,743 kW. A heat recovery steam boiler generates steam at a rate equal to 23,500 lbs/hr of steam. All electricity is used on-site.

- **Scenario 3.4D** is a combined cycle cogeneration system based on a packaged natural gas fired turbine/generator, heat recovery boiler, and back pressure steam turbine. Superheated steam from the supplementally fired recovery boiler passes through the steam turbine, drives a second generator and exhausts at the plant header pressure. The combined generator rating is 1,342 kW and steam is available at a rate of 10,500 lbs/hr. All electricity is used on-site.

- **Scenario 3.4E** is identical to 3.4A except that the unit operates at full capacity and excess electricity is sold to the Utility.

- **Scenario 3.4F** is identical to 3.4B except that the unit operates at full capacity and excess electricity is sold to the Utility. The poorer results reflect the wasted thermal energy in this scenario.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" Sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.4A Prime Mover: Kawasaki CTG 2200 gas turbine

ASSUMPTIONS:

Installed Cost:	3044 $(1000)			Elec. Purchase Price:	4.85 cents/kWh
Loan Amount:	0 $(1000)	Size:	1920.0 kW	Initial Fuel Cost:	2.70 $/MMBtu
Down Payment	3044 $(1000)	Gross Heat Rate:	17771.0 Btu/kWh	Boiler Efficiency:	75.00 %
Loan Terms:		Usable Heat:	9197.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	87.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	86.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			814.5	847.1	880.9	916.2	952.8	990.9	1033.5	1078.0	1124.3	1172.7
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			509.0	519.8	532.1	553.6	576.7	598.2	595.1	592.0	588.9	585.9
TOTAL REVENUES: $(1000)			1323.5	1366.8	1413.0	1469.8	1529.5	1589.1	1628.7	1670.0	1713.3	1758.6
EXPENSE												
Fuel:			746.2	762.0	780.1	811.6	845.4	876.9	872.5	867.9	863.4	858.9
O&M:			43.9	45.9	47.9	50.1	52.3	54.7	57.4	60.3	63.3	66.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			24.4	25.4	26.6	27.8	29.0	30.3	31.9	33.5	35.1	36.9
TOTAL EXPENSES: $(1000)			814.5	833.3	854.6	889.4	926.8	962.0	961.8	961.7	961.9	962.3
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			509.0	533.5	558.4	580.3	602.7	627.1	666.9	708.3	751.4	796.3
[Depreciation]:(Class 34)	274.0	958.9	1095.8	410.9								
[Depreciation]:Class 3(4%)	4.9	12.0	11.5	11.0	10.6	10.2	9.8	9.4	9.0	8.6	8.3	8.0
TAXES: 44.34 percent	-123.6	-430.5	-265.3	49.4	242.9	252.8	262.9	273.9	291.7	310.2	329.5	349.5
PROFIT(After Tax):$(1000)	123.6	430.5	774.3	484.1	315.5	327.5	339.8	353.2	375.2	398.1	421.9	446.7
PROFIT PRESENT VALUE (After Tax):$(1000)	123.6	380.9	606.4	335.5	193.5	177.8	163.2	150.1	141.1	132.5	124.3	116.5
CUMULATIVE CASH FLOW (NPV): $(1000)	-1094.0	-2489.9	-1715.6	-1231.5	-916.0	-588.5	-248.7	104.5	479.7	877.8	1299.7	1746.4
(based on profit NPV)	-1094.0	-2329.3	-1722.9	-1387.4	-1193.9	-1016.2	-852.9	-702.8	-561.7	-429.2	-304.9	-188.4

SIMPLE PAYBACK: 5.9 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 11.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 10.93%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.4B   Prime Mover: Kawasaki CTG 2800 gas turbine

ASSUMPTIONS:

Installed Cost:	3146 $(1000)			Elec. Purchase Price:	4.85 cents/kWh
Loan Amount:	0 $(1000)	Size:	2485.0 kW	Initial Fuel Cost:	2.70 $/MMBtu
Down Payment	3146 $(1000)	Gross Heat Rate:	18149.0 Btu/kWh	Boiler Efficiency:	75.00 %
Loan Terms:		Usable Heat:	9826.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	89.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	79.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1078.4	1121.5	1166.4	1213.0	1261.6	1312.0	1368.4	1427.3	1488.7	1552.7
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			646.6	660.2	675.9	703.2	732.5	759.8	755.9	752.0	748.1	744.2
TOTAL REVENUES: $(1000)			1725.0	1781.7	1842.3	1916.2	1994.1	2071.8	2124.4	2179.3	2236.8	2296.9
EXPENSE												
Fuel:			1009.1	1030.4	1054.8	1097.4	1143.1	1185.8	1179.7	1173.6	1167.5	1161.4
O&M:			58.1	60.7	63.5	66.3	69.3	72.4	76.1	79.9	83.8	88.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			25.2	26.3	27.5	28.7	30.0	31.4	32.9	34.6	36.3	38.1
TOTAL EXPENSES: $(1000)			1092.4	1117.4	1145.7	1192.4	1242.5	1289.6	1288.7	1288.0	1287.7	1287.6
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			632.6	664.3	696.5	723.8	751.6	782.3	835.7	891.3	949.1	1009.3
[Depreciation]:(Class 34)	283.1	991.0	1132.6	424.7								
[Depreciation]:Class 3(4%)	5.0	12.4	11.9	11.4	11.0	10.5	10.1	9.7	9.3	8.9	8.6	8.2
TAXES: 44.34 percent	-127.8	-444.9	-226.9	101.2	304.0	316.3	328.8	342.6	366.4	391.2	417.0	443.9
PROFIT(After Tax):$(1000)	127.8	444.9	859.6	563.2	392.5	407.5	422.8	439.7	469.3	500.0	532.1	565.4
PROFIT PRESENT VALUE (After Tax):$(1000)	127.8	393.7	673.2	390.3	240.8	221.2	203.1	186.9	176.5	166.5	156.7	147.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-1130.6	-2573.3	-1713.8	-1150.6	-758.1	-350.6	72.2	512.0	981.2	1481.2	2013.3	2578.7
(based on profit NPV)	-1130.6	-2407.4	-1734.2	-1343.9	-1103.1	-882.0	-678.9	-492.0	-315.5	-149.0	7.7	155.1

SIMPLE PAYBACK: 5.0 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 10.0 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 14.56%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.4C Prime Mover: Solar "Centaur Type H" gas turbine

ASSUMPTIONS:

Installed Cost:	3906 $(1000)			Elec. Purchase Price:	4.85 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.70 $/MMBtu
Down Payment	3906 $(1000)	Gross Heat Rate:	12530.0 Btu/kWh	Boiler Efficiency:	75.00 %
Loan Terms:		Usable Heat:	6347.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	74.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	73.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1350.6	1404.6	1460.8	1519.2	1580.0	1643.2	1713.8	1787.5	1864.4	1944.5
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			581.3	593.6	607.6	632.2	658.5	683.1	679.6	676.1	672.6	669.1
TOTAL REVENUES: $(1000)			1931.9	1998.1	2068.4	2151.4	2238.5	2326.3	2393.4	2463.6	2536.9	2613.6
EXPENSE												
Fuel:			872.5	890.9	912.0	948.8	988.4	1025.3	1020.0	1014.7	1009.5	1004.2
O&M:			72.8	76.1	79.5	83.1	86.8	90.7	95.2	100.0	105.0	110.3
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			31.2	32.7	34.1	35.7	37.3	38.9	40.9	42.9	45.1	47.3
TOTAL EXPENSES: $(1000)			976.5	999.6	1025.6	1067.6	1112.5	1154.9	1156.2	1157.7	1159.6	1161.8
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			955.3	998.5	1042.8	1083.8	1126.0	1171.3	1237.2	1305.9	1377.4	1451.8
[Depreciation]:(Class 34)	351.5	1230.4	1406.2	527.3								
[Depreciation]:Class 3(4%)	6.2	15.4	14.8	14.2	13.6	13.1	12.5	12.0	11.6	11.1	10.6	10.2
TAXES: 44.34 percent	-158.6	-552.4	-206.4	202.7	456.3	474.8	493.7	514.0	543.5	574.1	606.0	639.2
PROFIT(After Tax):$(1000)	158.6	552.4	1161.8	795.9	586.4	609.0	632.3	657.3	693.8	731.8	771.4	812.6
PROFIT PRESENT VALUE (After Tax):$(1000)	158.6	488.8	909.8	551.6	359.7	330.6	303.7	279.4	261.0	243.6	227.2	211.8
CUMULATIVE CASH FLOW (NPV): $(1000)	-1403.8	-3195.0	-2033.2	-1237.3	-650.9	-41.9	590.4	1247.7	1941.5	2673.3	3444.7	4257.3
(based on profit NPV)	-1403.8	-2988.9	-2079.1	-1527.5	-1167.8	-837.3	-533.6	-254.2	6.8	250.4	477.6	689.5

SIMPLE PAYBACK: 4.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.32%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.4D

Prime Mover: Combined cycle, gas/steam
Kawasaki CTG 1100 with supplemental firing

ASSUMPTIONS:
Installed Cost: 2007 $(1000)
Loan Amount: 0 $(1000)
Down Payment 2007 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 20.0%

Size: 1342.0 kW
Gross Heat Rate: 11624.0 Btu/kWh
Usable Heat: 7154.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.85 cents/kWh
Initial Fuel Cost: 2.70 $/MMBtu
Boiler Efficiency: 75.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			647.8	673.7	700.7	728.7	757.8	788.2	822.0	857.4	894.3	932.7
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			315.4	322.0	329.7	343.0	357.3	370.6	368.7	366.8	364.9	363.0
TOTAL REVENUES: $(1000)			963.2	995.7	1030.3	1071.7	1115.1	1158.8	1190.8	1224.2	1259.2	1295.7
EXPENSES												
Fuel:			388.2	396.4	405.8	422.2	439.8	456.2	453.9	451.5	449.2	446.9
O&M:			34.9	36.5	38.1	39.8	41.6	43.5	45.7	48.0	50.4	52.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			16.1	16.8	17.5	18.3	19.1	20.0	21.0	22.1	23.2	24.3
TOTAL EXPENSES: $(1000)			439.2	449.7	461.5	480.4	500.6	519.7	520.6	521.6	522.7	524.1
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	524.0	546.1	568.8	591.3	614.5	639.0	670.2	702.6	736.4	771.6
[Depreciation]: (Class 34)	180.6	632.2	722.5	270.9								
[Depreciation]: (Class 3, @ 4%)	3.2	7.9	7.6	7.3	7.0	6.7	6.4	6.2	5.9	5.7	5.5	5.3
TAXES: 44.34 percent	-81.5	-283.8	-91.4	118.8	249.1	259.2	269.6	280.6	294.5	309.0	324.1	339.8
PROFIT(After Tax):$(1000)	81.5	283.8	615.4	427.3	319.7	332.1	344.9	358.4	375.6	393.6	412.3	431.8
PROFIT PRESENT VALUE (After Tax):$(1000)	81.5	251.2	481.9	296.1	196.1	180.2	165.7	152.3	141.3	131.0	121.5	112.6
CUMULATIVE CASH FLOW	-721.3	-1641.7	-1026.3	-599.0	-279.3	52.8	397.7	756.1	1131.8	1525.4	1937.7	2369.5
(NPV): $(1000) (based on profit NPV)	-721.3	-1535.8	-1053.9	-757.7	-561.6	-381.4	-215.7	-63.4	77.9	209.0	330.4	443.0

SIMPLE PAYBACK: 4.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.3 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.58%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.4E   Prime Mover: Kawasaki CTG 2200 gas turbine

ASSUMPTIONS:

Installed Cost:	3211 $(1000)			Elec. Purchase Price:	4.85 cents/kWh
Loan Amount:	0 $(1000)	Size:	1920.0 kW	Initial Fuel Cost:	2.70 $/MMBtu
Down Payment	3211 $(1000)	Gross Heat Rate:	17771.0 Btu/kWh	Boiler Efficiency:	75.00 %
Loan Terms:		Usable Heat:	9197.0 Btu/kWh	Elec. Used On Site:	79.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			732.2	761.5	791.9	823.6	856.6	890.8	929.1	969.1	1010.7	1054.2
Electricity Sold:			101.7	106.3	111.1	116.1	121.3	126.8	133.1	139.8	146.8	154.1
Thermal Use:			580.0	592.3	606.3	630.8	657.1	681.6	678.2	674.6	671.1	667.6
TOTAL REVENUES: $(1000)			1414.0	1460.1	1509.4	1570.5	1635.0	1699.2	1740.4	1783.5	1828.6	1876.0
EXPENSE												
Fuel:			849.2	867.1	887.6	923.5	962.0	997.9	992.8	987.6	982.5	977.4
O&M:			50.0	52.2	54.5	57.0	59.6	62.3	65.4	68.6	72.1	75.7
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			25.7	26.8	28.1	29.3	30.6	32.0	33.6	35.3	37.1	38.9
TOTAL EXPENSES: $(1000)			924.8	946.1	970.2	1009.8	1052.2	1092.2	1091.8	1091.6	1091.6	1092.0
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			489.2	513.9	539.1	560.7	582.8	607.1	648.6	691.9	737.0	784.0
[Depreciation]:(Class 34)	289.0	1011.5	1156.0	433.5								
[Depreciation]:Class 3(4%)	5.1	12.6	12.1	11.6	11.2	10.7	10.3	9.9	9.5	9.1	8.8	8.4
TAXES: 44.34 percent	-130.4	-454.1	-301.0	30.5	234.1	243.9	253.8	264.8	283.4	302.8	322.9	343.9
PROFIT(After Tax):$(1000)	130.4	454.1	790.2	483.4	305.0	316.9	329.0	342.3	365.2	389.2	414.1	440.1
PROFIT PRESENT VALUE (After Tax):$(1000)	130.4	401.8	618.8	335.0	187.1	172.0	158.0	145.5	137.4	129.5	122.0	114.7
CUMULATIVE CASH FLOW (NPV): $(1000)	-1154.0	-2626.5	-1836.3	-1352.9	-1047.8	-731.0	-402.0	-59.7	305.5	694.7	1108.8	1548.8
(based on profit NPV)	-1154.0	-2457.1	-1838.3	-1503.2	-1316.1	-1144.2	-986.2	-840.7	-703.3	-573.7	-451.7	-337.0

SIMPLE PAYBACK: 6.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 12.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 9.43%
(Based on 10 Years)

```
                         COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.4F         Prime Mover:      Kawasaki CTG 2800 gas turbine

ASSUMPTIONS:
Installed Cost: 3249 $(1000)                                    Elec. Purchase Price:        4.85 cents/kWh
Loan Amount:       0 $(1000)     Size:                2485.0 kW   Initial Fuel Cost:           2.70 $/MMBtu
Down Payment    3249 $(1000)     Gross Heat Rate:    18149.0 Btu/kWh  Boiler Efficiency:      75.00 %
Loan Terms:                      Usable Heat:         9826.0 Btu/kWh  Elec. Used On Site:     79.00 %
      Int.      12.0 %           Load Factors:                    Electricity Sale Price:      2.54 cents/kWh
      Term       6.0 Years          Electrical:         99.0 %    Construction Period:         2.00 year(s)
Discount Rate:  13.0%               Thermal:            79.0 %    O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
===================================================================================================================

YEAR:                         1989     1990     1991     1992    1993    1994    1995    1996     1997     1998     1999     2000

REVENUE
      Displaced Electricity:                     947.7    985.6  1025.0  1066.0  1108.6  1153.0   1202.5   1254.2   1308.2   1364.4
      Electricity Sold:                          131.7    137.6   143.8   150.3   157.0   164.1    172.3    180.9    190.0    199.5
      Thermal Use:                               646.6    660.2   675.9   703.2   732.5   759.8    755.9    752.0    748.1    744.2
TOTAL REVENUES: $(1000)                         1725.9   1783.4  1844.6  1919.4  1998.1  2076.9   2130.8   2187.2   2246.2   2308.1

EXPENSE
      Fuel:                                     1122.4   1146.1  1173.3  1220.7  1271.6  1319.0   1312.3   1305.5   1298.7   1291.9
      O&M:                                        64.7     67.6    70.6    73.8    77.1    80.6     84.6     88.8     93.3     97.9
      P&I:                                         0.0      0.0     0.0     0.0     0.0     0.0
      Insurance:                                  26.0     27.2    28.4    29.7    31.0    32.4     34.0     35.7     37.5     39.4
TOTAL EXPENSES: $(1000)                         1213.1   1240.8  1272.3  1324.1  1379.7  1432.0   1430.9   1430.0   1429.4   1429.2

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                         512.8    542.5   572.4   595.3   618.5   644.9    699.9    757.2    816.8    878.9

[Depreciation]:(Class 34)    292.4   1023.4   1169.6    438.6

[Depreciation]:Class 3(4%)     5.2     12.8     12.3     11.6    11.3    10.9    10.4    10.0      9.6      9.2      8.9      8.5

TAXES:   44.34 percent      -132.0   -459.5   -296.7     40.9   248.8   259.1   269.6   281.5    306.1    331.6    358.2    385.9

PROFIT(After Tax):$(1000)    132.0    459.5    809.5    501.7   323.6   336.2   348.9   363.4    393.8    425.5    458.6    492.9

PROFIT PRESENT VALUE         132.0    406.6    634.0    347.7   198.5   182.5   167.6   154.5    148.1    141.7    135.1    128.5
(After Tax):$(1000)
CUMULATIVE CASH FLOW       -1167.6  -2657.6  -1848.1  -1346.4 -1022.8  -686.7  -337.8    25.6    419.4    844.9   1303.5   1796.4
(NPV): $(1000)
(based on profit NPV)      -1167.6  -2486.2  -1852.2  -1504.5 -1306.1 -1123.6  -956.0  -801.6   -653.4   -511.8   -376.7   -248.2
===================================================================================================================
SIMPLE PAYBACK:       6.0 years             INTERNAL RATE OF RETURN:    10.46%
(Based on 10 Year After-Tax Average)        (Based on 10 Years)
DISCOUNTED PAYBACK:  11.9 years
(Based on 10 Year After-Tax Average)
```

3.5 GROUP 33 - PRIMARY METAL INDUSTRIES
GROUP 34 - FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE MACHINERY AND TRANSPORTATION EQUIPMENT
GROUP 35 - MACHINERY, EXCEPT ELECTRICAL
GROUP 37 - TRANSPORTATION EQUIPMENT

a) Background Plant Data

This plant operates on a schedule of 16 hours per day and 5 days a week of production and 2 days of downtime for maintenance.

The total connected load at the main substation is over 250 MVA and the plant complex has over 150 transformer substations. Steam generated from a cogeneration system would be at 160 psig, dry and saturated.

Steam production can be generalized as follows:

Period	Average Steam Flow (lb/hr)
Winter	
Production day	460,000
Weekend	300,000
Summer	
Production day	90,000
Weekend	76,000
Shutdown	47,000

Electrical demand throughout the year is summarized below:

Period	Peak Demand (kW)	Minimum Demand (kW)
Production day	80,000	60,000
Weekend	42,000	40,000

b) Cogeneration Scenarios

- **Scenario 3.5A** involves the use of a back pressure steam turbine supplied with the 600 psig steam that can be generated in one of the plant boilers, and exhausting it to the plant's 160 psig header. Maximum electrical output is 1,250 kW.

- **Scenario 3.5B** involves the use of a packaged natural gas-fired turbine/generator cogeneration system with a heat recovery boiler. The nominal rating of the system is 8,589 kW. Supplementary firing is used to produce steam at the rate of 115,200 lbs/hr. The boiler produces steam at 160 psig, dry and saturated.

- **Scenario 3.5C** is similar to 3.5B except that a larger turbine/generator and boiler are used. The nominal rating of the system is 15,739 kW and supplementary firing is used to produce steam at the rate of 276,000 lbs/hr.

- **Scenario 3.5D** is similar to 3.5B except that a larger turbine/generator and boiler are used. The nominal rating of the system is 21,480 kW and supplementary firing is used to produce steam at the rate of 207,600 lbs/hr.

- **Scenario 3.5E** is similar to 3.5B except that a larger turbine/generator and boiler are used. The nominal rating of the system is 26,840 kW and supplementary firing is used to produce steam at the rate of 385,700 lbs/hr.

- **Scenario 3.5F** is similar to 3.5B except that a larger turbine/generator and boiler are used. The nominal rating of the system is 39,240 kW and supplementary firing is used to produce steam at the rate of 433,800 lbs/hr.

- **Scenario 3.5G** is similar to 3.5B except that a larger turbine/generator and boiler are used. The nominal rating of the system is 85,140 kW and supplementary firing is used to produce steam at the rate of 550,000 lbs/hr.

- **Scenario 3.5H** involves the use of a combined cycle cogeneration system based on a natural gas fired turbine/generator set, heat recovery steam generator, and a steam turbine/generator set. The nominal electrical output of the system is 44,536 kW and steam is exhausted to the plant header at a rate of 134,000 lbs./hr. at 160 psig.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" Sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

```
                                        COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..:MBEL-3.5A          Prime Mover:     Steam turbine
                                   existing boiler
ASSUMPTIONS:
Installed Cost:     800 $(1000)                                          Elec. Purchase Price:      3.78 cents/kWh
Loan Amount:          0 $(1000)    Size:            1250.0 kW            Initial Fuel Cost:         3.10 $/MMBtu
Down Payment        800 $(1000)    Gross Heat Rate: 55200.0 Btu/kWh      Boiler Efficiency:        80.00 %
Loan Terms:                        Usable Heat:     48960.0 Btu/kWh      Elec. Used On Site:      100.00 %
      Int.        12.0 %           Load Factors:                         Electricity Sale Price:    0.00 cents/kWh
      Term         6.0 Years          Electrical:     99.0 %             Construction Period:       2.00 year(s)
Discount Rate:    13.0%               Thermal:        98.0 %             O&M Charge:                0.10 cents/kWh
IRR Guess:        20.0%
==================================================================================================================

YEAR:                           1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE:
      Displaced Electricity:                   470.3   489.1   508.7   529.0   550.2   572.2   596.8   622.4   649.2   677.1
      Electricity Sold:                          0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
      Thermal Use:                            2163.9  2209.5  2261.9  2353.3  2451.4  2542.9  2529.9  2516.7  2503.7  2490.6
TOTAL REVENUES: $(1000)                       2634.2  2698.6  2770.6  2882.3  3001.6  3115.0  3126.7  3139.2  3152.8  3167.7

EXPENSES
      Fuel:                                   2464.6  2516.6  2576.2  2680.3  2792.1  2896.2  2881.4  2866.5  2851.6  2836.7
      O&M:                                      10.8    11.3    11.8    12.4    12.9    13.5    14.2    14.9    15.6    16.4
      P&I:                                       0.0     0.0     0.0     0.0     0.0     0.0
      Insurance:                                 6.4     6.7     7.0     7.3     7.6     8.0     8.4     8.8     9.2     9.7
TOTAL EXPENSES: $(1000)                       2481.8  2534.6  2595.0  2700.0  2812.6  2917.7  2904.0  2890.1  2876.4  2862.8

TAX INCENTIVES:

PROFIT (Pre Tax)$(1000)          0.0     0.0   152.4   164.0   175.5   182.3   189.0   197.3   222.7   249.0   276.4   304.9

[Depreciation]: (Class 34)      72.0   252.0   288.0   108.0

[Depreciation]: (Class 3, @ 4%)  1.3     3.1     3.0     2.9     2.8     2.7     2.6     2.5     2.4     2.3     2.2     2.1

TAXES:    44.34 percent        -32.5  -113.1   -61.5    23.6    76.6    79.7    82.6    86.4    97.7   109.4   121.6   134.3

PROFIT(After Tax):$(1000)       32.5   113.1   213.8   140.5    98.9   102.7   106.3   110.9   125.0   139.6   154.6   170.6

PROFIT PRESENT VALUE            32.5   100.1   167.5    97.4    60.7    55.7    51.1    47.2    47.0    46.5    45.6    44.5
(After Tax):$(1000)
CUMULATIVE CASH FLOW          -287.5  -654.4  -440.5  -300.1  -201.1   -98.5     7.9   118.8   243.8   383.4   538.2   708.6
(NPV): $(1000)
(Based on profit NPV)         -287.5  -612.2  -444.7  -347.3  -286.7  -230.9  -179.9  -132.7   -85.7   -39.2     6.4    50.9
==================================================================================================================
SIMPLE PAYBACK:              4.8 years       INTERNAL RATE OF RETURN:   14.93%
(Based on 10 Year After-Tax Average)         (Based on 10 Years)
DISCOUNTED PAYBACK:          9.9 years
(Based on 10 Year After-Tax Average)
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COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.5B

Prime Mover: Solar "Mars" Gas Turbine
with supplemental firing

ASSUMPTIONS:

Installed Cost:	8944 $(1000)			Elec. Purchase Price:	3.78 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	8944 $(1000)	Gross Heat Rate:	19409.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	13484.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			3231.4	3360.6	3495.1	3634.9	3780.3	3931.5	4100.5	4276.8	4460.7	4652.6
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			4094.9	4181.3	4280.4	4453.3	4639.1	4812.1	4787.5	4762.7	4737.9	4713.2
TOTAL REVENUES: $(1000)			7326.3	7541.9	7775.5	8088.2	8419.3	8743.5	8888.1	9039.5	9198.6	9365.8
EXPENSE												
Fuel:			4763.5	4864.0	4979.3	5180.5	5396.5	5597.8	5569.2	5540.3	5511.5	5482.8
O&M:			223.5	233.5	244.0	255.0	266.5	278.5	292.4	307.0	322.4	335.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			71.6	74.8	78.1	81.7	85.3	89.2	93.6	98.3	103.2	108.4
TOTAL EXPENSES: $(1000)			5056.5	5172.3	5301.5	5517.1	5748.3	5965.4	5955.3	5945.6	5937.1	5929.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			2267.8	2369.6	2474.0	2571.1	2671.0	2778.1	2932.8	3093.9	3261.6	3436.1
[Depreciation]:(Class 34)	805.0	2817.4	3219.8	1207.4								
[Depreciation]:Class 3(4%)	14.3	35.2	33.8	32.4	31.1	29.9	28.7	27.6	26.5	25.4	24.4	23.4
TAXES: 44.34 percent	-363.3	-1264.8	-437.1	500.9	1083.2	1126.8	1171.6	1219.6	1288.7	1360.6	1435.4	1513.2
PROFIT(After Tax):$(1000)	363.3	1264.8	2704.9	1868.7	1390.8	1444.3	1499.4	1558.5	1644.1	1733.3	1826.2	1922.9
PROFIT PRESENT VALUE (After Tax):$(1000)	363.3	1119.3	2118.3	1295.1	853.0	783.9	720.2	662.5	618.5	577.0	538.0	501.3
CUMULATIVE CASH FLOW (NPV): $(1000)	-3214.3	-7315.9	-4611.0	-2742.3	-1351.5	92.8	1592.2	3150.7	4794.9	6528.2	8354.4	10277.3
(based on profit NPV)	-3214.3	-6844.0	-4725.7	-3430.6	-2577.6	-1793.7	-1073.5	-411.0	207.4	784.4	1322.4	1823.7

SIMPLE PAYBACK: 4.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.09%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.5C

Prime Mover: Solar "Jupiter" Gas Turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost:15893 $(1000)
Loan Amount: 0 $(1000)
Down Payment 15893 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 15739.0 kW
Gross Heat Rate: 23883.0 Btu/kWh
Usable Heat: 17625.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 96.0 %

Elec. Purchase Price: 3.78 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			5921.4	6158.2	6404.5	6660.7	6927.2	7204.2	7514.0	7837.1	8174.1	8525.6
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			9808.2	10015.2	10252.5	10666.7	11111.5	11526.0	11467.2	11407.6	11348.3	11289.3
TOTAL REVENUES: $(1000)			15729.6	16173.4	16657.1	17327.5	18038.7	18730.2	18981.2	19244.7	19522.4	19814.9
EXPENSE												
Fuel:			10741.1	10967.7	11227.7	11681.3	12168.4	12622.3	12557.9	12492.6	12427.6	12363.0
O&M:			409.5	427.9	447.2	467.3	488.3	510.3	535.8	562.6	590.7	620.3
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			127.1	132.9	138.8	145.1	151.6	158.4	166.4	174.7	183.4	192.6
TOTAL EXPENSES: $(1000)			11277.7	11528.5	11813.7	12293.7	12808.3	13291.0	13260.1	13229.9	13201.8	13175.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			4451.8	4644.9	4843.4	5033.8	5230.4	5439.2	5721.2	6014.8	6320.6	6639.0
[Depreciation]:(Class 34)	1430.4	5006.3	5721.5	2145.6								
[Depreciation]:Class 3(4%)	25.4	62.6	60.1	57.7	55.3	53.1	51.0	49.0	47.0	45.1	43.3	41.6
TAXES: 44.34 percent	-645.5	-2247.5	-589.6	1082.6	2123.0	2208.4	2296.5	2390.0	2515.9	2647.0	2783.4	2925.3
PROFIT(After Tax):$(1000)	645.5	2247.5	5041.4	3562.2	2720.4	2825.4	2933.8	3049.2	3205.2	3367.9	3537.3	3713.7
PROFIT PRESENT VALUE (After Tax):$(1000)	645.5	1989.0	3948.2	2468.8	1668.5	1533.5	1409.2	1296.1	1205.7	1121.1	1042.0	968.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-5711.7	-13000.0	-7958.5	-4396.3	-1675.9	1149.4	4083.3	7132.5	10337.7	13705.6	17242.9	20956.6
(based on profit NPV)	-5711.7	-12161.5	-8213.3	-5744.5	-4076.1	-2542.6	-1133.4	162.7	1368.4	2489.5	3531.5	4499.7

SIMPLE PAYBACK: 3.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 21.25%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.5D		Prime Mover:	GE LM2500 Gas Turbine with supplemental firing		
ASSUMPTIONS:					
Installed Cost:	20136 $(1000)			Elec. Purchase Price:	3.78 cents/kWh
Loan Amount:	0 $(1000)	Size:	21480.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	20136 $(1000)	Gross Heat Rate:	15974.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	9712.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	97.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			8081.3	8404.5	8740.7	9090.3	9453.9	9832.1	10254.9	10695.8	11155.7	11635.4
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			7300.8	7454.9	7631.6	7939.9	8271.0	8579.5	8535.7	8491.3	8447.2	8403.3
TOTAL REVENUES: $(1000)			15382.1	15859.4	16372.2	17030.2	17724.9	18411.6	18790.6	19187.2	19602.9	20038.7
EXPENSE												
Fuel:			9804.6	10011.5	10248.8	10662.8	11107.5	11521.8	11463.0	11403.4	11344.1	11285.1
O&M:			558.8	584.0	610.3	637.7	666.4	696.4	731.2	767.8	806.2	846.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			161.1	168.3	175.9	183.8	192.1	200.7	210.8	221.3	232.4	244.0
TOTAL EXPENSES: $(1000)			10524.6	10763.8	11035.0	11484.4	11966.0	12418.9	12405.0	12392.5	12382.7	12375.6
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			4857.5	5095.6	5337.3	5545.8	5758.9	5992.6	6385.5	6794.6	7220.2	7663.1
[Depreciation]:(Class 34)	1812.2	6342.8	7249.0	2718.4								
[Depreciation]:Class 3(4%)	32.2	79.3	76.1	73.0	70.1	67.3	64.6	62.0	59.6	57.2	54.9	52.7
TAXES: 44.34 percent	-817.8	-2847.6	-1094.1	1021.7	2335.5	2429.2	2524.8	2629.6	2804.9	2987.4	3177.1	3374.4
PROFIT(After Tax):$(1000)	817.8	2847.6	5951.6	4073.9	3001.8	3116.6	3234.1	3363.0	3580.6	3807.2	4043.1	4288.6
PROFIT PRESENT VALUE (After Tax):$(1000)	817.8	2520.0	4661.0	2823.4	1841.1	1691.6	1553.4	1429.5	1346.9	1267.4	1191.1	1118.0
CUMULATIVE CASH FLOW (NPV): $(1000)	-7236.6	-16470.6	-10519.0	-6445.1	-3443.3	-326.6	2907.4	6270.4	9851.0	13658.3	17701.4	21990.0
(based on profit NPV)	-7236.6	-15408.3	-10747.3	-7923.9	-6082.8	-4391.2	-2837.8	-1408.4	-61.5	1205.9	2396.9	3515.0

SIMPLE PAYBACK: 4.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.24%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.5E

Prime Mover: GE MS5001PA Gas Turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost:21977 $(1000)
Loan Amount: 0 $(1000)
Down Payment 21977 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 26840.0 kW
Gross Heat Rate: 21311.0 Btu/kWh
Usable Heat: 14441.0 Btu/kWh
Load Factors:
Electrical: 98.0 %
Thermal: 97.0 %

Elec. Purchase Price: 3.78 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			9995.8	10395.6	10811.5	11243.9	11693.7	12161.4	12684.4	13229.8	13798.7	14392.0
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			13564.7	13850.9	14179.2	14752.0	15367.1	15940.3	15859.0	15776.6	15694.5	15612.9
TOTAL REVENUES: $(1000)			23560.5	24246.5	24990.6	25995.9	27060.8	28101.8	28543.4	29006.4	29493.2	30005.0
EXPENSE												
Fuel:			16179.3	16520.7	16912.2	17595.5	18329.2	19012.9	18915.9	18817.6	18719.7	18622.4
O&M:			691.2	722.4	754.9	788.8	824.3	861.4	904.5	949.7	997.2	1047.1
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			175.8	183.7	192.0	200.6	209.7	219.1	230.1	241.6	253.6	266.3
TOTAL EXPENSES: $(1000)			17046.4	17426.8	17859.1	18585.0	19363.2	20093.4	20050.5	20008.8	19970.6	19935.8
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			6514.1	6819.7	7131.5	7411.0	7697.6	8008.3	8492.9	8997.5	9522.7	10069.2
[Depreciation]:(Class 34)	1977.9	6922.8	7911.7	2966.9								
[Depreciation]:Class 3(4%)	35.2	86.5	83.0	79.7	76.5	73.5	70.5	67.7	65.0	62.4	59.9	57.5
TAXES: 44.34 percent	-892.6	-3107.9	-656.5	1673.0	3128.2	3253.4	3381.8	3520.9	3736.9	3961.8	4195.8	4439.2
PROFIT(After Tax):$(1000)	892.6	3107.9	7170.6	5146.7	4003.3	4157.5	4315.8	4487.5	4756.0	5035.7	5326.9	5630.0
PROFIT PRESENT VALUE (After Tax):$(1000)	892.6	2750.4	5615.7	3566.9	2455.3	2256.5	2072.9	1907.4	1789.0	1676.3	1569.2	1467.7
CUMULATIVE CASH FLOW (NPV): $(1000)	-7898.2	-17976.5	-10805.9	-5659.1	-1655.8	2501.7	6817.5	11305.0	16061.0	21096.7	26423.5	32053.5
(based on profit NPV)	-7898.2	-16817.0	-11201.4	-7634.4	-5179.1	-2922.6	-849.6	1057.8	2846.8	4523.1	6092.4	7560.1

SIMPLE PAYBACK: 3.6 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 22.78%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO. .MBEL-3.5F

Prime Mover: GE MS6001B Gas Turbine with supplemental firing

ASSUMPTIONS:

Installed Cost:	29601 $(1000)			Elec. Purchase Price:	3.78 cents/kWh
Loan Amount:	0 $(1000)	Size:	39240.0 kW	Initial Fuel Cost:	3.10 $/MMBtu
Down Payment	29601 $(1000)	Gross Heat Rate:	17584.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	11110.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	98.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	82.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			14613.8	15198.4	15806.3	16438.6	17096.1	17780.0	18544.5	19341.9	20173.6	21041.1
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			12897.8	13169.9	13482.0	14026.7	14611.6	15156.6	15079.3	15000.9	14922.9	14845.3
TOTAL REVENUES: $(1000)			27511.6	28368.3	29288.4	30465.3	31707.8	32936.6	33623.9	34342.9	35096.6	35886.4
EXPENSE												
Fuel:			19517.3	19929.1	20401.5	21225.7	22110.8	22935.5	22818.6	22699.9	22581.9	22464.4
O&M:			1010.6	1056.1	1103.6	1153.3	1205.2	1259.4	1322.4	1388.5	1457.9	1530.8
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			236.8	247.5	258.6	270.2	282.4	295.1	309.9	325.4	341.6	358.7
TOTAL EXPENSES: $(1000)			20764.7	21232.7	21763.7	22649.2	23598.4	24490.0	24450.8	24413.7	24381.4	24353.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			6746.9	7135.6	7524.7	7816.1	8109.4	8446.6	9173.1	9929.1	10715.2	11532.5
[Depreciation]:(Class 34)	2664.1	9324.3	10656.4	3996.1								
[Depreciation]:Class 3(4%)	47.4	116.5	111.8	107.4	103.1	99.0	95.0	91.2	87.6	84.0	80.7	77.5
TAXES: 44.34 percent	-1202.3	-4186.1	-1783.1	1344.4	3290.7	3421.8	3553.6	3704.8	4028.5	4365.3	4715.3	5079.2
PROFIT(After Tax):$(1000)	1202.3	4186.1	8529.9	5791.2	4234.0	4394.3	4555.8	4741.8	5144.6	5563.8	5999.8	6453.3
PROFIT PRESENT VALUE (After Tax):$(1000)	1202.3	3704.5	6680.2	4013.6	2596.8	2385.1	2188.2	2015.6	1935.2	1852.1	1767.5	1682.4
CUMULATIVE CASH FLOW	-10638.1	-24212.7	-15682.7	-9891.6	-5657.6	-1263.3	3292.5	8034.3	13178.9	18742.7	24742.5	31195.9
(NPV): $(1000) (based on profit NPV)	-10638.1	-22651.0	-15970.8	-11957.2	-9360.5	-6975.4	-4787.2	-2771.6	-836.4	1015.7	2783.2	4465.5

SIMPLE PAYBACK: 4.4 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.9 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 17.52%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

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PLANT CODE NO.MBEL-3.5G        Prime Mover:      GE MS7001 Gas Turbine
                               with supplemental firing
ASSUMPTIONS:
Installed Cost48000 $(1000)                                        Elec. Purchase Price:        3.78 cents/kWh
Loan Amount:       0 $(1000)   Size:              85140.0 kW       Initial Fuel Cost:           3.10 $/MMBtu
Down Payment  48000 $(1000)    Gross Heat Rate:   13544.0 Btu/kWh  Boiler Efficiency:          80.00 %
Loan Terms:                    Usable Heat:        7284.0 Btu/kWh  Elec. Used On Site:         87.00 %
      Int.    12.0 %           Load Factors:                       Electricity Sale Price:      3.76 cents/kWh
      Term     6.0 Years          Electrical:        64.0 %        Construction Period:         2.00 year(s)
Discount Rate: 13.0%              Thermal:           63.0 %        O&M Charge:                  0.30 cents/kWh
IRR Guess:     40.0%
===================================================================================================================

YEAR:                        1989     1990     1991     1992     1993     1994    1995     1996     1997     1998     1999     2000

REVENUE
      Displaced Electricity:                18015.3  18735.9  19485.4  20264.8 21075.4  21918.4  22860.9  23843.9  24869.2  25938.6
      Electricity Sold:                      2672.7   2793.0   2918.7   3050.1  3187.3   3330.7   3497.3   3672.1   3855.7   4048.5
      Thermal Use:                          14096.2  14393.6  14734.8  15330.0 15969.3  16565.0  16480.5  16394.8  16309.5  16224.7
TOTAL REVENUES: $(1000)                     34784.3  35922.6  37138.8  38644.9 40232.0  41814.1  42838.6  43910.8  45034.5  46211.8

EXPENSE
      Fuel:                                 21301.4  21750.9  22266.4  23165.9 24131.9  25032.1  24904.4  24774.9  24646.1  24517.9
      O&M:                                   1432.0   1496.4   1563.8   1634.1  1707.7   1784.5   1873.7   1967.4   2065.8   2169.1
      P&I:                                      0.0      0.0      0.0      0.0     0.0      0.0
      Insurance:                              384.0    401.3    419.3    438.2   457.9    478.5    502.5    527.6    554.0    581.7
TOTAL EXPENSES: $(1000)                     23117.4  23648.6  24249.5  25238.3 26297.5  27295.1  27280.6  27269.9  27265.8  27268.7

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                    11666.9  12274.0  12889.4  13406.6 13934.5  14519.0  15558.0  16640.9  17768.6  18943.2

[Depreciation](Class 34)  4320.0  15120.0  17280.0   6480.0

[Depreciation]:Class 3(4    76.8    188.9    181.4    174.1    167.2    160.5   154.0    147.9    142.0    136.3    130.8    125.6

TAXES:  44.34 percent    -1949.5  -6788.0  -2569.3   2491.9   5641.0   5873.3  6110.2   6372.1   6835.5   7318.2   7820.6   8343.7

PROFIT(After Tax):$(1000  1949.5   6788.0  14236.2   9782.2   7248.3   7533.3  7824.2   8146.8   8722.6   9322.8   9948.0  10599.5

PROFIT PRESENT VALUE      1949.5   6007.1  11149.0   6779.5   4445.5   4088.8  3758.1   3462.9   3281.1   3103.4   2930.6   2763.3
(After Tax):$(1000)
CUMULATIVE CASH FLOW    -17250.5 -39262.5 -25026.3 -15244.2  -7995.8   -462.5  7361.7  15508.5  24231.1  33553.8  43501.9  54101.3
(NPV): $(1000)
(based on profit NPV)   -17250.5 -36730.1 -25581.1 -18801.6 -14356.1 -10267.3 -6509.2  -3046.3    234.8   3338.2   6268.8   9032.0
===================================================================================================================
SIMPLE PAYBACK:      4.2 years              INTERNAL RATE OF RETURN:      18.60%
(Based on 10 Year After-Tax Average)        (Based on 10 Years)
DISCOUNTED PAYBACK: 8.6 years
(Based on 10 Year After-Tax Average)
```

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE .: MBEL-3.5H

Prime Mover: GE MS6001 Gas Turbine/Steam Turbine combined cycle

ASSUMPTIONS:

Installed Cost32839 $(1000)
Loan Amount: 0 $(1000)
Down Payment 32839 $(1000)
Loan Terms:
  Int. 12.0 %
  Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 20.0%

Size: 44536.0 kW
Gross Heat Rate: 10650.0 Btu/kWh
Usable Heat: 3034.0 Btu/kWh
Load Factors:
  Electrical: 99.0 %
  Thermal: 82.0 %

Elec. Purchase Price: 3.78 cents/kWh
Initial Fuel Cost: 3.10 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENU												
Displaced Electricity:			16755.4	17425.7	18122.7	18847.6	19601.5	20385.6	21262.1	22176.4	23130.0	24124.6
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			3997.6	4081.9	4178.7	4347.5	4528.8	4697.7	4673.8	4649.5	4625.3	4601.2
TOTAL REVENUES: $(1000)			20753.0	21507.6	22301.4	23195.1	24130.3	25083.3	25935.9	26825.9	27755.3	28725.8
EXPENS												
Fuel:			13553.3	13839.2	14167.2	14739.6	15354.2	15926.9	15845.7	15763.3	15681.3	15599.8
O&M:			1158.7	1210.8	1265.3	1322.3	1381.8	1444.0	1516.2	1592.0	1671.6	1755.1
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			262.7	274.5	286.9	299.8	313.3	327.4	343.8	360.9	379.0	397.9
TOTAL EXPENSES: $(1000)			14974.7	15324.6	15719.4	16361.6	17049.3	17698.3	17705.6	17716.2	17731.9	17752.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			5778.4	6183.0	6581.9	6833.4	7081.0	7385.0	8230.3	9109.7	10023.4	10972.9
Depreciation: Class 34	2955.5	10344.3	11822.0	4433.3								
Depreciation:Class 3(4%)	52.5	129.3	124.1	119.1	114.4	109.8	105.4	101.2	97.1	93.2	89.5	85.9
TAXES: 44.34 percent	-1333.8	-4644.0	-2734.8	723.0	2867.7	2981.3	3093.0	3229.6	3606.2	3997.9	4404.7	4827.3
PROFIT(After Tax):$(1000)	1333.8	4644.0	8513.1	5460.0	3714.2	3852.2	3988.0	4155.4	4624.0	5111.8	5618.7	6145.6
PROFIT PRESENT VALUE (After Tax):$(1000)	1333.8	4109.7	6667.0	3784.0	2278.0	2090.8	1915.5	1766.3	1739.4	1701.6	1655.2	1602.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-11801.8	-26861.3	-18348.1	-12888.1	-9173.9	-5321.8	-1333.7	2821.6	7445.7	12557.4	18176.1	24321.8
(based on profit NPV)	-11801.8	-25128.8	-18461.7	-14677.7	-12399.7	-10308.9	-8393.4	-6627.1	-4887.7	-3186.1	-1530.9	71.3

SIMPLE PAYBACK: 5.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 10.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 13.07%
(Based on 10 Years)

3.6 GROUP 32 - STONE, CLAY AND GLASS PRODUCTS
GROUP 33 - PRIMARY METAL INDUSTRIES
GROUP 34 - FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY AND TRANSPORTATION EQUIPMENT
GROUP 37 - TRANSPORTATION EQUIPMENT

a) Background Plant Data

This plant operates a weekly cycle of five 20 hour days, 49 weeks of the year. The plant is shut down for the remaining 3 weeks for maintenance and to implement production changes.

The electrical demand was analyzed for summer and winter months. The results can be generalized as follows:

Period	**Peak Demand** (kW)	**Average Demand** (kW)
Summer	23,000	16,000
Winter	25,000	19,000

Summer average steam load: 81,000 lb/hr

Winter average steam load: 330,000 lb/hr

b) Cogeneration Scenarios

- **Scenario 3.6A** involves the installation of a packaged natural gas fired turbine generator set and heat recovery boiler. Nominal electrical output of the system is 15,739 kW. Steam is generated at a rate of 62,300 lbs/hr.
- **Scenario 3.6B** is the same as 3.6A but using a smaller turbine/generator and boiler. Nominal electrical output is 8,589 kW and steam output is 42,700 lbs/hr.
- **Scenario 3.6C** is the same as 3.6B except that the boiler is supplementally fired to increase the steam output to 88,200 lbs/hr.
- **Scenario 3.6D** is a combined cycle cogeneration system that uses a natural gas fired turbine/generator set, a heat recovery steam generator, and a steam turbine generator set. Nominal electrical output is 16,609 kW and steam is delivered to the plant header at a rate of 49,500 lbs/hr. at 150 psig.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" Sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.6A

Prime Mover: Solar "Jupiter" Gas Turbine

ASSUMPTIONS:

Installed Cost:11655 $(1000)
Loan Amount: 0 $(1000)
Down Payment 11655 $(1000)
Loan Terms:
    Int. 12.0 %
    Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 15739.0 kW
Gross Heat Rate: 10801.0 Btu/kWh
Usable Heat: 3988.0 Btu/kWh
Load Factors:
    Electrical: 96.0 %
    Thermal: 89.0 %

Elec. Purchase Price: 4.10 cents/kWh
Initial Fuel Cost: 2.79 $/MMBtu
Boiler Efficiency: 82.00 %
Elec. Used On Site: 100.00 %
Electricity Sale Price: 0.00 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			6228.0	6477.1	6736.2	7005.7	7285.9	7577.3	7903.2	8243.0	8597.4	8967.1
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			1769.7	1807.0	1849.9	1924.6	2004.9	2079.6	2069.0	2058.3	2047.6	2036.9
TOTAL REVENUES: $(1000)			7997.7	8284.2	8586.1	8930.3	9290.8	9657.0	9972.2	10301.3	10645.0	11004.1
EXPENSE												
Fuel:			4239.4	4328.8	4431.4	4610.5	4802.7	4981.9	4956.4	4930.7	4905.0	4879.5
O&M:			397.1	414.9	433.6	453.1	473.5	494.8	519.6	545.5	572.8	601.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			93.2	97.4	101.8	106.4	111.2	116.2	122.0	128.1	134.5	141.2
TOTAL EXPENSES: $(1000)			4729.7	4841.2	4966.9	5170.0	5387.4	5592.9	5598.0	5604.3	5612.4	5622.2
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			3268.0	3443.0	3619.2	3760.3	3903.3	4064.1	4374.2	4696.9	5032.6	5381.8
[Depreciation]:(Class 34)	1049.0	3671.3	4195.8	1573.4								
[Depreciation]:Class 3(4%)	18.6	45.9	44.0	42.3	40.6	39.0	37.4	35.9	34.5	33.1	31.8	30.5
TAXES: 44.34 percent	-473.4	-1648.2	-430.9	810.2	1586.8	1650.0	1714.2	1786.1	1924.2	2068.0	2217.4	2372.8
PROFIT(After Tax):$(1000)	473.4	1648.2	3698.9	2632.8	2032.5	2110.2	2189.2	2278.0	2449.9	2629.0	2815.3	3009.0
PROFIT PRESENT VALUE (After Tax):$(1000)	473.4	1458.6	2896.8	1824.6	1246.5	1145.4	1051.5	968.3	921.6	875.2	829.3	784.5
CUMULATIVE CASH FLOW (NPV): $(1000)	-4188.6	-9533.4	-5834.5	-3201.7	-1169.3	941.0	3130.1	5408.1	7858.1	10487.1	13302.3	16311.4
(based on profit NPV)	-4188.6	-6918.5	-6021.7	-4197.1	-2950.6	-1805.2	-753.7	214.6	1136.2	2011.3	2840.7	3625.1

SIMPLE PAYBACK: 3.7 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 21.85%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.6B   Prime Mover: Solar "Mars" Gas Turbine

ASSUMPTIONS:

Installed Cost:	7512 $(1000)			Elec. Purchase Price:	4.10 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.79 $/MMBtu
Down Payment	7512 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	82.00 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	96.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			3504.9	3645.1	3790.9	3942.6	4100.3	4264.3	4447.6	4638.9	4838.4	5046.4
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			1308.9	1336.5	1368.2	1423.5	1482.9	1538.2	1530.3	1522.4	1514.4	1506.6
TOTAL REVENUES: $(1000)			4813.9	4981.7	5159.2	5366.1	5583.1	5802.4	5978.0	6161.3	6352.8	6553.0
EXPENSE												
Fuel:			2466.2	2518.2	2577.9	2682.1	2793.9	2898.1	2883.3	2868.3	2853.4	2838.6
O&M:			223.5	233.5	244.0	255.0	266.5	278.5	292.4	307.0	322.4	338.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			60.1	62.8	65.6	68.6	71.7	74.9	78.6	82.6	86.7	91.0
TOTAL EXPENSES: $(1000)			2749.7	2814.5	2887.6	3005.6	3132.0	3251.5	3254.4	3257.9	3262.5	3268.1
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			2064.1	2167.1	2271.6	2360.4	2451.1	2551.0	2723.6	2903.3	3090.3	3284.9
[Depreciation]:(Class 34)	676.1	2366.3	2704.3	1014.1								
[Depreciation]:Class 3(4%)	12.0	29.6	28.4	27.2	26.2	25.1	24.1	23.1	22.2	21.3	20.5	19.7
TAXES: 44.34 percent	-305.1	-1062.3	-296.5	499.2	995.6	1035.5	1076.1	1120.8	1197.8	1277.9	1361.2	1447.8
PROFIT(After Tax):$(1000)	305.1	1062.3	2360.6	1668.0	1276.0	1324.9	1375.0	1430.1	1525.8	1625.5	1729.2	1837.1
PROFIT PRESENT VALUE (After Tax):$(1000)	305.1	940.1	1848.7	1156.0	782.6	719.1	660.4	607.9	573.9	541.1	509.4	478.9
CUMULATIVE CASH FLOW (NPV): $(1000)	-2699.7	-6144.6	-3784.0	-2116.1	-840.1	484.9	1859.8	3290.0	4815.8	6441.2	8170.4	10007.5
(based on profit NPV)	-2699.7	-5748.3	-3899.6	-2743.6	-1961.0	-1241.9	-581.5	26.4	600.3	1141.4	1650.8	2129.7

SIMPLE PAYBACK: 3.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 21.18%
(Based on 10 Years)

```
                                  COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.6C          Prime Mover:      Solar "Mars" Gas Turbine
                                  with supplemental firing
ASSUMPTIONS:
Installed Cost: 8944 $(1000)                                          Elec. Purchase Price:        4.10 cents/kWh
Loan Amount:       0 $(1000)      Size:                 8589.0 kW     Initial Fuel Cost:           2.79 $/MMBtu
Down Payment    8944 $(1000)      Gross Heat Rate:     16358.0 Btu/kWh  Boiler Efficiency:        82.00 %
Loan Terms:                       Usable Heat:         10349.0 Btu/kWh  Elec. Used On Site:      100.00 %
      Int.      12.0 %            Load Factors:                       Electricity Sale Price:      0.00 cents/kWh
      Term       6.0 Years           Electrical:          97.0 %      Construction Period:         2.00 year(s)
Discount Rate:  13.0%                Thermal:             96.0 %      O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
=====================================================================================================================

YEAR:                        1989     1990     1991     1992    1993    1994    1995    1996     1997     1998     1999     2000

REVENUE
      Displaced Electricity:                 3434.1   3571.5  3714.3  3862.9  4017.4  4178.1   4357.8   4545.2   4740.6   4944.5
      Electricity Sold:                         0.0      0.0     0.0     0.0     0.0     0.0      0.0      0.0      0.0      0.0
      Thermal Use:                           2703.3   2760.3  2625.7  2939.9  3062.5  3176.7   3160.5   3144.1   3127.7   3111.5
TOTAL REVENUES: $(1000)                      6137.4   6331.8  6540.1  6802.8  7079.9  7354.8   7518.3   7689.3   7868.3   8055.9

EXPENSE
      Fuel:                                  3540.3   3615.0  3700.6  3850.1  4010.7  4160.3   4139.1   4117.5   4096.1   4074.8
      O&M:                                    218.9    228.6   239.1   249.9   261.1   272.8    286.5    300.8    315.9    331.6
      P&I:                                      0.0      0.0     0.0     0.0     0.0     0.0
      Insurance:                               71.6     74.8    78.1    81.7    85.3    89.2     93.6     98.3    103.2    108.4
TOTAL EXPENSES: $(1000)                      3830.8   3918.5  4017.9  4181.6  4357.1  4522.3   4519.2   4516.7   4515.2   4514.9

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                     2306.6   2413.3  2522.2  2621.2  2722.8  2832.5   2999.1   3172.6   3353.1   3541.1

[Depreciation]:(Class 34)   805.0   2817.4   3219.8   1207.4

[Depreciation]:Class 3(4%)   14.3     35.2     33.6     32.4    31.1    29.9    28.7    27.6     26.5     25.4     24.4     23.4

TAXES:   44.34 percent     -363.3  -1264.8   -419.9    520.3  1104.5  1149.0  1194.6  1243.7   1318.1   1395.5   1476.0   1559.7

PROFIT(After Tax):$(1000)   363.3   1264.8   2726.5   1893.0  1417.7  1472.2  1528.2  1588.8   1681.0   1777.1   1877.2   1981.3

PROFIT PRESENT VALUE        363.3   1119.3   2135.3   1311.9   869.5   799.0   734.0   675.3    632.3    591.6    553.0    516.5
(After Tax):$(1000)
CUMULATIVE CASH FLOW      -3214.3  -7315.9  -4589.4  -2696.4 -1278.7   193.5  1721.7  3310.5   4991.6   6768.7   8645.8  10627.2
(NPV): $(1000)
(based on profit NPV)     -3214.3  -6844.0  -4708.8  -3396.8 -2527.4 -1728.3  -994.3  -318.9    313.4    905.0   1458.0   1974.5
=====================================================================================================================
SIMPLE PAYBACK:       4.1 years               INTERNAL RATE OF RETURN:    19.54%
(Based on 10 Year After-Tax Average)          (Based on 10 Years)
DISCOUNTED PAYBACK:   8.3 years
(Based on 10 Year After-Tax Average)
```

```
                                 COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.6D          Prime Mover:      Combined cycle, gas/steam
                                  Solar "Jupiter"/Dresser Rand steam turbine
ASSUMPTIONS:
Installed Cost:12236 $(1000)                                      Elec. Purchase Price:        4.10 cents/kWh
Loan Amount:        0 $(1000)     Size:             16609.0 kW    Initial Fuel Cost:           2.79 $/MMBtu
Down Payment   12236 $(1000)      Gross Heat Rate:  10235.0 Btu/kWh  Boiler Efficiency:       82.00 %
Loan Terms:                       Usable Heat:       3003.0 Btu/kWh  Elec. Used On Site:     100.00 %
       Int.     12.0 %            Load Factors:                   Electricity Sale Price:      0.00 cents/kWh
       Term      6.0 Years            Electrical:       99.0 %    Construction Period:         2.00 year(s)
Discount Rate:  13.0%                 Thermal:          93.0 %    O&M Charge:                  0.30 cents/kWh
IRR Guess:      20.0%
===========================================================================================================

YEAR:                          1989     1990     1991     1992     1993     1994     1995     1996     1997     1998     1999     2000

REVENUE
    Displaced Electricity:                     6777.7   7048.8   7330.7   7624.0   7928.9   8246.1   8600.6   8970.5   9356.2   9758.5
    Electricity Sold:                             0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
    Thermal Use:                               1469.5   1500.5   1536.0   1598.1   1664.7   1726.8   1718.0   1709.1   1700.2   1691.3
TOTAL REVENUES: $(1000)                        8247.1   8549.2   8866.8   9222.0   9593.6   9972.9  10318.7  10679.6  11056.4  11449.9

EXPENSE
    Fuel:                                      4371.8   4464.0   4569.8   4754.4   4952.7   5137.4   5111.2   5084.6   5058.2   5031.9
    O&M:                                        432.1    451.6    471.9    493.1    515.3    538.5    565.4    593.7    623.4    654.5
    P&I:                                          0.0      0.0      0.0      0.0      0.0      0.0
    Insurance:                                   97.9    102.3    106.9    111.7    116.7    122.0    128.1    134.5    141.2    148.3
TOTAL EXPENSES: $(1000)                        4901.8   5017.9   5148.6   5359.3   5584.7   5797.9   5804.7   5812.8   5822.8   5834.7

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                       3345.4   3531.4   3718.2   3862.8   4008.9   4175.0   4513.9   4866.7   5233.6   5615.1

[Depreciation]:(Class 34)    1101.2   3854.3   4405.0   1651.9

[Depreciation]:Class 3(4%)     19.6     48.2     46.2     44.4     42.6     40.9     39.3     37.7     36.2     34.7     33.4     32.0

TAXES:   44.34 percent       -497.0  -1730.4   -490.3    813.7   1629.7   1694.6   1760.1   1834.5   1985.4   2142.5   2305.8   2475.6

PROFIT(After Tax):$(1000)     497.0   1730.4   3835.7   2717.7   2088.4   2168.2   2248.8   2340.5   2528.5   2724.2   2927.8   3139.6

PROFIT PRESENT VALUE          497.0   1531.3   3003.9   1883.5   1280.9   1176.8   1080.1    994.9    951.1    906.9    862.5    818.5
(After Tax):$(1000)
CUMULATIVE CASH FLOW        -4397.4 -10008.7  -6173.0  -3455.3  -1366.9    801.3   3050.1   5390.6   7919.1  10643.3  13571.1  16710.7
(NPV): $(1000)
(based on profit NPV)       -4397.4  -9363.1  -6359.2  -4475.7  -3194.9  -2018.1   -937.9     56.9   1008.0   1914.9   2777.4   3595.9
===========================================================================================================
SIMPLE PAYBACK:        3.7 years           INTERNAL RATE OF RETURN:     21.38%
(Based on 10 Year After-Tax Average)       (Based on 10 Years)
DISCOUNTED PAYBACK:    7.7 years
(Based on 10 Year After-Tax Average)
```

3.7 GROUP 23 - APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIALS

This plant operates on a weekly schedule of five, 9 hour shifts, 52 weeks of the year.

The electrical demand was analyzed for summer and winter months and was found to be consistent throughout the year at 300 kW.

The plant's estimated thermal energy requirements are as follows:

Summer average steam load: 2,100 lbs/hr
Winter average steam load: 2,900 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.7A** involves the installation of a packaged natural gas fired internal combustion engine/generator. Heat is recovered from the engine cooling water and engine exhaust is used to generate 1,300 lbs/hr process steam at 100 psig dry and saturated. Nominal electrical output is 290 kW.

c) Summary Results

The "Cogeneration System Cash Flow Analysis" sheet follows. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

```
PLANT CODE NO..:MBEL-3.7A          Prime Mover:    Waukesha gas engine 3600 G

ASSUMPTIONS:
Installed Cost:     501 $(1000)                                          Elec. Purchase Price:       5.75 cents/kWh
Loan Amount:          0 $(1000)       Size:              290.0 kW        Initial Fuel Cost:          4.59 $/MMBtu
Down Payment        501 $(1000)       Gross Heat Rate: 10421.0 Btu/kWh   Boiler Efficiency:         80.00 %
Loan Terms:                           Usable Heat:      4568.0 Btu/kWh   Elec. Used On Site:       100.00 %
     Int.         12.0 %              Load Factors:                      Electricity Sale Price:     0.00 cents/kWh
     Term          6.0 Years             Electrical:      50.0 %         Construction Period:        2.00 year(s)
Discount Rate:    13.0%                  Thermal:         48.0 %         O&M Charge:                 0.80 cents/kWh
IRR Guess:        20.0%
=======================================================================================================================

YEAR:                               1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE:
      Displaced Electricity:                        83.8    87.2    90.7    94.3    98.1   102.0   106.4   110.9   115.7   120.7
      Electricity Sold:                              0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
      Thermal Use:                                  34.0    34.7    35.5    36.9    38.5    39.9    39.7    39.5    39.3    39.1
TOTAL REVENUES: $(1000)                            117.8   121.9   126.2   131.2   136.5   141.9   146.1   150.4   155.0   159.8

EXPENSES
      Fuel:                                         64.6    65.9    67.5    70.2    73.2    75.9    75.5    75.1    74.7    74.3
      O&M:                                          10.2    10.6    11.1    11.6    12.1    12.7    13.3    14.0    14.7    15.4
      P&I:                                           0.0     0.0     0.0     0.0     0.0     0.0
      Insurance:                                     4.0     4.2     4.4     4.6     4.8     5.0     5.2     5.5     5.8     6.1
TOTAL EXPENSES: $(1000)                             78.7    80.7    83.0    86.4    90.1    93.5    94.0    94.6    95.2    95.8

TAX INCENTIVES:

PROFIT (Pre Tax)$(1000)              0.0     0.0    39.0    41.1    43.2    44.8    46.5    48.4    52.0    55.9    59.9    64.0

[Depreciation]: (Class 34)          45.1   157.8   180.4    67.6

[Depreciation]: (Class 3, @ 4%)      0.8     2.0     1.9     1.8     1.7     1.7     1.6     1.5     1.5     1.4     1.4     1.3

TAXES:    44.34 percent            -20.3   -70.8   -63.5   -12.6    18.4    19.1    19.9    20.8    22.4    24.1    25.9    27.8

PROFIT(After Tax):$(1000)           20.3    70.8   102.5    53.7    24.8    25.7    26.6    27.6    29.6    31.7    33.9    36.2

PROFIT PRESENT VALUE                20.3    62.7    80.3    37.2    15.2    13.9    12.8    11.7    11.1    10.6    10.0     9.4
(After Tax):$(1000)
CUMULATIVE CASH FLOW              -180.1  -409.8  -307.3  -253.6  -228.8  -203.1  -176.5  -148.9  -119.3   -87.5   -53.6   -17.4
(NPV): $(1000)
(based on profit NPV)             -180.1  -383.4  -303.1  -265.9  -250.6  -236.7  -223.9  -212.2  -201.1  -190.5  -180.5  -171.1
=======================================================================================================================
SIMPLE PAYBACK:            10.4 years        INTERNAL RATE OF RETURN:   -0.85%
(Based on 10 Year After-Tax Average)         (Based on 10 Years)
DISCOUNTED PAYBACK:        19.3 years
(Based on 10 Year After-Tax Average)
```

3.8 GROUP 20 - FOOD AND KINDRED PRODUCTS

a) Background Plant Data

The plant operates continuously 24 hours a day, 7 days a week. There is a 2 week shutdown in the summer.

The total connected electrical load in the plant is approximately 2000 kVA. Steam generated by a cogeneration system would be at 150 psig, dry and saturated.

The electrical demand was analyzed for summer and winter months and can be generalized as follows:

Period	**Peak Demand** (kW)	**Average Demand** (kW)
Summer	1028	734
Winter	1072	805

Summer average steam load: 30,000 lbs/hr
Winter average steam load: 41,000 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.8A** involves the installation of a packaged natural gas fired turbine/generator set with a heat recovery boiler. The nominal electric output of the system is 3,743 kW. Steam is produced at a rate equal to 23,600 lbs/hr. Excess electricity is sold to the Utility.

- **Scenario 3.8B** uses the same turbine/generator as 3.8A, but the boiler can be supplementally fired to increase steam output to 39,800 lbs/hr. Excess electricity is sold to the Utility.

- **Scenario 3.8C** is similar to 3.8A except a larger turbine/generator and boiler are used. The nominal electric output of the system is 8,589 kW and steam is generated at a rate of 42,500 lbs/hr. Excess electricity is sold to the Utility.

- **Scenario 3.8D** is the same as 3.8C except that the turbine firing rate is controlled to track the thermal energy demand.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" Sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.8A Prime Mover: Solar "Centaur Type H" gas turbine

ASSUMPTIONS:

Installed Cost:	4074 $(1000)			Elec. Purchase Price:	4.30 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	4074 $(1000)	Gross Heat Rate:	12530.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	6347.0 Btu/kWh	Elec. Used On Site:	16.10 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	96.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	95.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			250.1	260.1	270.5	281.3	292.6	304.3	317.4	331.0	345.2	360.1
Electricity Sold:			1137.5	1188.7	1242.2	1298.1	1356.5	1417.5	1488.4	1562.8	1641.0	1723.0
Thermal Use:			750.9	766.7	784.9	816.6	850.6	882.4	877.9	873.3	868.8	864.2
TOTAL REVENUES: $(1000)			2138.5	2215.5	2297.6	2396.0	2499.7	2604.2	2683.6	2767.1	2855.0	2947.4
EXPENSE												
Fuel:			1186.4	1211.4	1240.1	1290.2	1344.0	1394.1	1387.0	1379.8	1372.6	1365.5
O&M:			94.4	98.7	103.1	107.8	112.6	117.7	123.6	129.7	136.2	143.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			32.6	34.1	35.6	37.2	38.9	40.6	42.6	44.8	47.0	49.4
TOTAL EXPENSES: $(1000)			1313.4	1344.1	1378.8	1435.2	1495.5	1552.4	1553.2	1554.3	1555.9	1557.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			825.1	871.4	918.8	960.8	1004.2	1051.8	1130.4	1212.8	1299.1	1389.5
[Depreciation]:(Class 34)	366.7	1283.3	1466.6	550.0								
[Depreciation]:Class 3(4%)	6.5	16.0	15.4	14.8	14.2	13.6	13.1	12.6	12.0	11.6	11.1	10.7
TAXES: 44.34 percent	-165.5	-576.1	-291.3	135.9	401.1	420.0	439.5	460.8	495.9	532.6	571.1	611.4
PROFIT(After Tax):$(1000)	165.5	576.1	1116.4	735.4	517.7	540.8	564.8	591.0	634.5	680.2	728.0	776.1
PROFIT PRESENT VALUE (After Tax):$(1000)	165.5	509.8	874.3	509.7	317.5	293.5	271.3	251.2	238.7	226.4	214.5	202.6
CUMULATIVE CASH FLOW (NPV): $(1000)	-1464.1	-3332.4	-2216.0	-1480.6	-962.9	-422.1	142.7	733.6	1368.2	2048.3	2776.4	3554.5
(based on profit NPV)	-1464.1	-3117.5	-2243.2	-1733.5	-1416.0	-1122.5	-851.2	-600.0	-361.3	-134.9	79.6	282.4

SIMPLE PAYBACK: 4.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 15.15%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.8B

Prime Mover: Solar "Centaur Type H" gas turbine with supplemental firing

ASSUMPTIONS:

Installed Cost:	4737 $(1000)			Elec. Purchase Price:	4.30 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	4737 $(1000)	Gross Heat Rate:	16821.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	10709.0 Btu/kWh	Elec. Used On Site:	16.10 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	96.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	95.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			250.1	260.1	270.5	281.3	292.6	304.3	317.4	331.0	345.2	360.1
Electricity Sold:			1137.5	1188.7	1242.2	1298.1	1356.5	1417.5	1488.4	1562.8	1641.0	1723.0
Thermal Use:			1266.9	1293.6	1324.3	1377.8	1435.2	1488.6	1481.2	1473.5	1465.8	1458.2
TOTAL REVENUES: $(1000)			2654.5	2742.4	2837.0	2957.2	3084.3	3210.6	3287.0	3367.3	3452.0	3541.3
EXPENSE												
Fuel:			1592.6	1626.2	1664.8	1732.0	1804.3	1871.6	1862.0	1852.3	1842.7	1833.1
O&M:			94.4	98.7	103.1	107.8	112.6	117.7	123.6	129.7	136.2	143.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			37.9	39.6	41.4	43.2	45.2	47.2	49.6	52.1	54.7	57.4
TOTAL EXPENSES: $(1000)			1725.0	1764.5	1809.3	1883.0	1962.1	2036.5	2035.2	2034.1	2033.6	2033.6
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			929.5	977.9	1027.7	1074.1	1122.2	1174.1	1251.8	1333.2	1418.4	1507.7
[Depreciation]:(Class 34)	426.3	1492.2	1705.3	639.5								
[Depreciation]:Class 3(4%)	7.6	18.6	17.9	17.2	16.5	15.8	15.2	14.6	14.0	13.5	12.9	12.4
TAXES: 44.34 percent	-192.4	-669.9	-351.9	142.4	448.4	469.3	490.9	514.1	548.8	585.2	623.2	663.0
PROFIT(After Tax):$(1000)	192.4	669.9	1281.5	835.5	579.3	604.9	631.4	660.0	703.0	748.0	795.2	844.7
PROFIT PRESENT VALUE (After Tax):$(1000)	192.4	592.8	1003.6	579.0	355.3	328.3	303.3	280.5	264.4	249.0	234.3	220.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-1702.4	-3874.7	-2593.3	-1757.8	-1178.5	-573.6	57.8	717.8	1420.8	2168.8	2964.0	3808.7
(based on profit NPV)	-1702.4	-3624.8	-2621.2	-2042.2	-1686.9	-1358.6	-1055.3	-774.8	-510.4	-261.4	-27.1	193.1

SIMPLE PAYBACK: 5.0 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 10.1 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 14.29%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.8C Prime Mover: Solar "Mars" Gas Turbine

ASSUMPTIONS:

Installed Cost:	7681 $(1000)			Elec. Purchase Price:	4.30 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	7681 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	7.04 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	96.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	87.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			250.9	261.0	271.4	282.3	293.6	305.3	318.4	332.1	346.4	361.3
Electricity Sold:			2892.1	3022.2	3158.2	3300.4	3448.9	3604.1	3784.3	3973.5	4172.2	4380.8
Thermal Use:			1245.8	1272.0	1302.2	1354.8	1411.3	1463.9	1456.5	1448.9	1441.4	1433.9
TOTAL REVENUES: $(1000)			4388.8	4555.3	4731.8	4937.4	5153.7	5373.3	5559.2	5754.5	5959.9	6175.9
EXPENSE												
Fuel:			2425.7	2476.9	2535.6	2638.1	2748.1	2850.6	2836.0	2821.3	2806.6	2792.0
O&M:			216.7	226.4	236.6	247.3	258.4	270.0	283.5	297.7	312.6	328.2
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2703.9	2767.6	2839.4	2955.5	3079.8	3197.2	3200.0	3203.4	3207.9	3213.3
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1684.9	1787.7	1892.5	1982.0	2074.0	2176.1	2359.2	2551.1	2752.1	2962.6
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-491.9	320.5	827.3	867.4	908.7	954.4	1036.0	1121.5	1211.0	1304.7
PROFIT(After Tax):$(1000)	312.0	1086.2	2176.8	1467.1	1065.2	1114.5	1165.3	1221.7	1323.2	1429.6	1541.1	1657.9
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1704.7	1016.8	653.3	604.9	559.7	519.3	497.7	475.9	454.0	432.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-4106.1	-2638.9	-1573.7	-459.2	706.1	1927.9	3251.1	4680.7	6221.7	7879.6
(based on profit NPV)	-2760.4	-5877.6	-4172.9	-3156.1	-2502.7	-1897.8	-1338.1	-818.8	-321.1	154.8	608.8	1041.0

SIMPLE PAYBACK: 4.4 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 9.1 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 17.06%
(Based on 10 Years)

```
                              COGENERATION SYSTEM CASH FLOW ANALYSIS


PLANT CODE NO..MBEL-3.8D         Prime Mover:      Solar "Mars" Gas Turbine
                                 electric generation is restricted
ASSUMPTIONS:                     to match thermal demand
Installed Cost: 7681 $(1000)                                          Elec. Purchase Price:        4.30 cents/kWh
Loan Amount:       0 $(1000)     Size:               8589.0 kW        Initial Fuel Cost:           2.83 $/MMBtu
Down Payment    7681 $(1000)     Gross Heat Rate:   11165.0 Btu/kWh   Boiler Efficiency:          79.20 %
Loan Terms:                      Usable Heat:        5011.0 Btu/kWh   Elec. Used On Site:          6.32 %
      Int.      12.0 %           Load Factors:                        Electricity Sale Price:      3.76 cents/kWh
      Term       6.0 Years          Electrical:        88.0 %         Construction Period:         2.00 year(s)
Discount Rate:  13.0%               Thermal:           87.0 %         O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
==========================================================================================================================

YEAR:                         1989      1990      1991      1992    1993    1994    1995    1996      1997      1998      1999      2000

REVENUE
      Displaced Electricity:                       206.5     214.8   223.4   232.3   241.6   251.2     262.0     273.3     285.1     297.3
      Electricity Sold:                           2671.6    2791.8  2917.5  3048.8  3185.9  3329.3    3495.8    3670.6    3854.1    4046.8
      Thermal Use:                                1245.8    1272.0  1302.2  1354.8  1411.3  1463.9    1456.5    1448.9    1441.4    1433.9
TOTAL REVENUES: $(1000)                           4123.9    4278.6  4443.0  4635.8  4838.8  5044.5    5214.3    5392.8    5580.5    5778.0

EXPENSE
      Fuel:                                       2223.6    2270.5  2324.3  2418.2  2519.1  2613.0    2599.7    2586.2    2572.7    2559.4
      O&M:                                         198.6     207.6   216.9   226.7   236.9   247.5     259.9     272.9     286.5     300.9
      P&I:                                           0.0       0.0     0.0     0.0     0.0     0.0
      Insurance:                                    61.4      64.2    67.1    70.1    73.3    76.6      80.4      84.4      88.6      93.1
TOTAL EXPENSES: $(1000)                           2483.7    2542.3  2608.3  2715.0  2829.2  2937.1    2940.0    2943.5    2947.9    2953.3

TAX INCENTIVES:                                                                                     .

PROFIT (Pre Tax):$(1000)                          1640.2    1736.3  1834.7  1920.8  2009.6  2107.4    2274.3    2449.3    2632.6    2824.7

[Depreciation]:(Class 34)     691.3    2419.5     2765.2    1036.9

[Depreciation]:Class 3(4%)     12.3      30.2       29.0      27.9    26.7    25.7    24.7    23.7      22.7      21.8      20.9      20.1

TAXES:   44.34 percent       -312.0   -1086.2     -511.7     297.8   801.6   840.3   880.1   923.9     996.3    1076.3    1156.0    1243.6

PROFIT(After Tax):$(1000)     312.0    1086.2     2151.9    1438.5  1033.0  1080.5  1129.5  1183.4    1275.9    1372.9    1474.6    1581.1

PROFIT PRESENT VALUE          312.0     961.3     1685.2     997.0   633.6   586.5   542.5   503.0     480.0     457.0     434.4     412.2
(After Tax):$(1000)
CUMULATIVE CASH FLOW        -2760.4   -6282.8    -4130.9   -2692.4 -1659.3  -578.8   550.7  1734.1    3010.0    4383.0    5857.6    7438.7
(NPV): $(1000)
(based on profit NPV)       -2760.4   -5877.6    -4192.4   -3195.3 -2561.8 -1975.3 -1432.8  -929.8    -449.8       7.2     441.6     853.8
==========================================================================================================================
SIMPLE PAYBACK:        4.6 years          INTERNAL RATE OF RETURN:     16.37%
(Based on 10 Year After-Tax Average)      (Based on 10 Years)
DISCOUNTED PAYBACK:   9.3 years
(Based on 10 Year After-Tax Average)
```

3.9 GROUP 25 - FURNITURE AND FIXTURES

a) Background Plant Data

This plant operates on a schedule of five, 8 hour days per week. The plant is shut down for maintenance for a total of 3 weeks per year.

The electrical demand was analyzed for summer and winter months and can be generalized as follows:

Period	Peak Demand (kW)	Average Demand (kW)
Summer	7,660	1,560
Winter	9,350	1,820

Summer average steam load: 1,000 lbs/hr
Winter average steam load: 2,800 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.9A** involves the installation of a natural gas fired internal combustion engine/generator set. Heat is recovered from the cooling water and engine exhaust and used to produce steam. The nominal electric output of the system is 1,475 kW. Steam is generated at a rate of 7,900 lbs/hr.
- **Scenario 3.9B** is identical to 3.9A except a smaller engine/generator set is used. Electrical output is reduced to 500 kW and steam output is 2,673 lbs./hr.

c) Summary of Results

The "Cogeneration System Cash Flow Analysis" sheet follows. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

```
PLANT CODE NO..:MBEL-3.9A          Prime Mover:     Waukesha gas engine 9500GSI

ASSUMPTIONS:
Installed Cost:     1802 $(1000)                                      Elec. Purchase Price:      5.37 cents/kWh
Loan Amount:           0 $(1000)   Size:              1475.0 kW       Initial Fuel Cost:         4.99 $/MMBtu
Down Payment        1802 $(1000)   Gross Heat Rate: 11268.0 Btu/kWh   Boiler Efficiency:        70.00 %
Loan Terms:                        Usable Heat:      5360.0 Btu/kWh   Elec. Used On Site:      100.00 %
        Int.        12.0 %         Load Factors:                      Electricity Sale Price:    0.00 cents/kWh
        Term         6.0 Years         Electrical:      99.0 %        Construction Period:       2.00 year(s)
Discount Rate:      13.0%              Thermal:         64.0 %        O&M Charge:                0.80 cents/kWh
IRR Guess:          20.0%
=================================================================================================================

YEAR:                            1989    1990    1991    1992    1993    1994    1995    1996    1997    1998    1999    2000

REVENUE:
        Displaced Electricity:                  788.4   819.9   852.7   886.8   922.3   959.1  1000.4  1043.4  1088.3  1135.1
        Electricity Sold:                         0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
        Thermal Use:                            335.8   342.9   351.0   365.2   380.5   394.7   392.6   390.6   388.6   386.5
TOTAL REVENUES: $(1000)                        1124.2  1162.8  1203.7  1252.0  1302.7  1353.8  1393.0  1434.0  1476.8  1521.6

EXPENSES
        Fuel:                                   764.5   780.6   799.1   831.4   866.1   898.4   893.8   889.1   884.5   879.9
        O&M:                                    102.3   106.9   111.8   116.8   122.0   127.5   133.9   140.6   147.6   155.0
        P&I:                                      0.0     0.0     0.0     0.0     0.0     0.0
        Insurance:                               14.4    15.1    15.7    16.5    17.2    18.0    18.9    19.8    20.8    21.8
TOTAL EXPENSES: $(1000)                         881.2   902.6   926.6   964.6  1005.3  1043.8  1046.5  1049.5  1052.9  1056.8

TAX INCENTIVES:

PROFIT (Pre Tax)$(1000)           0.0     0.0   243.0   260.2   277.1   287.4   297.4   310.0   346.5   384.5   423.9   464.9

[Depreciation]: (Class 34)      162.2   567.6   648.7   243.3

[Depreciation]: (Class 3, @ 4%)   2.9     7.1     6.8     6.5     6.3     6.0     5.8     5.6     5.3     5.1     4.9     4.7

TAXES:    44.34 percent         -73.2  -254.8  -182.9     4.6   120.1   124.8   129.3   135.0   151.3   168.2   185.8   204.0

PROFIT(After Tax):$(1000)        73.2   254.8   425.9   255.6   157.0   162.6   168.1   175.0   195.2   216.3   238.1   260.8

PROFIT PRESENT VALUE             73.2   225.5   333.5   177.1    96.3    88.3    80.8    74.4    73.4    72.0    70.1    68.0
(After Tax):$(1000)
CUMULATIVE CASH FLOW           -647.6 -1474.0 -1048.1  -792.5  -635.5  -472.8  -304.7  -129.7    65.5   281.8   519.9   780.7
(NPV): $(1000)
(based on profit NPV)          -647.6 -1378.9 -1045.4  -868.2  -771.9  -683.6  -602.9  -528.5  -455.1  -383.1  -312.9  -244.9
=================================================================================================================
SIMPLE PAYBACK:            6.5 years          INTERNAL RATE OF RETURN:    8.39%
(Based on 10 Year After-Tax Average)          (Based on 10 Years)
DISCOUNTED PAYBACK:       13.0 years
(Based on 10 Year After-Tax Average)
```

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..:MBEL-3.9B   Prime Mover: Waukesha gas engine 3600 GSI

ASSUMPTIONS:

Installed Cost:	830 $(1000)			Elec. Purchase Price:	5.37 cents/kWh
Loan Amount:	0 $(1000)	Size:	550.0 kW	Initial Fuel Cost:	4.99 $/MMBtu
Down Payment	830 $(1000)	Gross Heat Rate:	11265.0 Btu/kWh	Boiler Efficiency:	70.00 %
Loan Terms:		Usable Heat:	4889.0 Btu/kWh	Elec. Used On Site:	100.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	0.00 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.80 cents/kWh
IRR Guess:	20.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE:												
Displaced Electricity:			294.0	305.7	317.9	330.7	343.9	357.6	373.0	389.1	405.8	423.2
Electricity Sold:			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal Use:			174.9	178.6	182.8	190.2	198.1	205.5	204.5	203.4	202.4	201.3
TOTAL REVENUES: $(1000)			468.9	484.3	500.8	520.9	542.0	563.2	577.5	592.5	608.2	624.6
EXPENSES												
Fuel:			285.0	291.0	297.9	309.9	322.8	334.9	333.2	331.5	329.7	328.0
O&M:			38.2	39.9	41.7	43.5	45.5	47.6	49.9	52.4	55.0	57.8
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			6.6	6.9	7.3	7.6	7.9	8.3	8.7	9.1	9.6	10.1
TOTAL EXPENSES: $(1000)			329.8	337.8	346.8	361.0	376.3	390.7	391.8	393.0	394.4	395.9
TAX INCENTIVES:												
PROFIT (Pre Tax)$(1000)	0.0	0.0	139.1	146.5	154.0	159.8	165.8	172.5	185.7	199.5	213.8	228.7
[Depreciation]: (Class 34)	74.7	261.5	298.8	112.1								
[Depreciation]: (Class 3, @ 4%)	1.3	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2
TAXES: 44.34 percent	-33.7	-117.4	-72.2	13.9	67.0	69.6	72.3	75.3	81.3	87.4	93.8	100.4
PROFIT(After Tax):$(1000)	33.7	117.4	211.3	132.6	87.0	90.2	93.4	97.1	104.5	112.1	120.0	128.3
PROFIT PRESENT VALUE (After Tax):$(1000)	33.7	103.9	165.5	91.9	53.3	49.0	44.9	41.3	39.3	37.3	35.4	33.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-298.3	-678.9	-467.6	-335.1	-248.1	-157.9	-64.4	32.7	137.1	249.2	369.2	497.5
(based on profit NPV)	-298.3	-635.1	-469.7	-377.8	-324.4	-275.5	-230.6	-189.3	-150.0	-112.7	-77.4	-43.9

SIMPLE PAYBACK: 5.8 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 11.5 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 11.25%
(Based on 10 Years)

3.10 GROUP 20 - FOOD AND KINDRED PRODUCTS

a) Background Plant Data

The plant operates on a weekly cycle of 5½ days of production operation and 1½ days of downtime including maintenance and preparatory activities for the coming week.

Steam generated from a cogeneration system should be at 250 psig, dry and saturated conditions.

Evaluation of the complement of plant boilers and personnel suggests that payroll savings could be realized with the introduction of a new gas turbine and boiler cogeneration facility. This benefit has been incorporated into the analysis as a negative expense that is escalated according to the Ontario average consumer price index.

The steam production profile is as follows:

Steam Production Rate (lbs/hour)	**Duration** (Hours/Year)
160,000 or greater	875
155,000	25
145,000	100
137,000	50
113,000	1,700
101,000	150
95,000	1,175
85,000	1,275
80,000	110
61,000	2,000
52,000	220
23,500	1,080
	8,760 hours

The electrical consumption and demand data by month are provided in the following table.

Month	**Total** kWh	**Average Demand** kW	**Total Billed Demand** (kW)
Jan	1,723,000	2,316	4,128
Feb	2,112,000	3,143	4,276
Mar	1,809,600	2,432	4,224
Apr	2,102,400	2,920	4,224
May	2,107,200	2,832	4,464
Jun	2,107,200	2,927	4,776

Month	Total kWh	Average Demand kW	Total Billed Demand (kW)
Jul	2,251,200	3,026	5,011
Aug	3,288,000	4,419	8,054
Sep	4,372,800	6,073	8,573
Oct	2,419,200	3,252	6,854
Nov	2,006,400	2,787	4,248
Dec	1,699,200	2,284	3,970
TOTAL	27,998,400		

b) Cogeneration Scenarios

- **Scenario 3.10A** includes the installation of a packaged natural gas fired turbine generator set with a heat recovery boiler. The nominal rating of the system is 3,743 kW with steam produced at the rate of 23,400 lbs/hr. Surplus electricity is sold to the Utility.

- **Scenario 3.10B** includes the same 3,743 kW generator and related turbine as in the previous case, but supplemental firing is provided to increase the maximum steam output from the boiler to 49,100 lbs/hr.

- **Scenario 3.10C** includes the installation of a packaged natural gas fired turbine generator set with a heat recovery boiler. The nominal rating of the system is 8,589 kW with steam produced at the rate of 42,500 lbs/hr.

- **Scenario 3.10D** includes the same 8,589 kW generator and related turbine as in the previous case, but supplemental firing is included to increase the maximum steam energy output from the boiler to 114,200 lbs/hr.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.10A Prime Mover: Solar "Centaur Type H" gas turbine

ASSUMPTIONS:

Installed Cost:	4074 $(1000)			Elec. Purchase Price:	4.60 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.58 $/MMBtu
Down Payment	4074 $(1000)	Gross Heat Rate:	12530.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	634[illegible].0 Btu/kWh	Elec. Used On Site:	79.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	99.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	98.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%			Labour Savings:	325.0 $(1000)/year

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1353.8	1408.0	1464.3	1522.9	1583.8	1647.1	1717.9	1791.8	1868.9	1949.2
Electricity Sold:			198.3	207.3	216.6	226.3	236.5	247.2	259.5	272.5	286.1	300.4
Thermal Use:			699.1	713.8	730.8	760.3	792.0	821.5	817.3	813.1	808.9	804.6
TOTAL REVENUES: $(1000)			2251.2	2329.1	2411.6	2509.5	2612.3	2715.8	2794.8	2877.4	2963.8	3054.3
EXPENSE												
Fuel:			1115.4	1138.9	1165.9	1213.0	1263.6	1310.7	1304.0	1297.2	1290.5	1283.8
O&M:			97.4	101.8	106.3	111.1	116.1	121.4	127.4	133.8	140.5	147.5
Labour Savings:			-372.3	-389.1	-406.6	-424.9	-444.0	-464.0	-487.2	-511.5	-537.1	-563.9
Insurance:			32.6	34.1	35.6	37.2	38.9	40.6	42.6	44.8	47.0	49.4
TOTAL EXPENSES: $(1000)			873.0	885.7	901.3	936.4	974.6	1008.7	986.9	964.3	940.9	916.7
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1378.2	1443.4	1510.4	1573.0	1637.7	1707.1	1807.9	1913.1	2023.0	2137.6
[Depreciation]:(Class 34)	366.7	1283.3	1466.6	550.0								
[Depreciation]:Class 3(4%)	6.5	16.0	15.4	14.8	14.2	13.6	13.1	12.6	12.0	11.6	11.1	10.7
TAXES: 44.34 percent	-165.5	-576.1	-46.0	389.6	663.4	691.4	720.4	751.4	796.3	843.1	892.1	943.1
PROFIT(After Tax):$(1000)	165.5	576.1	1424.2	1053.8	847.0	881.6	917.3	955.7	1011.6	1070.0	1130.9	1194.5
PROFIT PRESENT VALUE (After Tax):$(1000)	165.5	509.8	1115.4	730.4	519.5	478.5	440.6	406.2	380.5	356.2	333.1	311.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-1464.1	-3332.4	-1908.2	-854.3	-7.4	874.2	1791.6	2747.3	3758.9	4828.9	5959.8	7154.3
(based on profit NPV)	-1464.1	-3117.5	-2002.1	-1271.7	-752.3	-273.8	166.8	573.1	953.6	1309.8	1642.9	1954.3

SIMPLE PAYBACK: 3.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 6.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 26.09%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.10B

Prime Mover: Solar "Centaur Type H" gas turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost: 4737 $(1000)
Loan Amount: 0 $(1000)
Down Payment 4737 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 3743.0 kW
Gross Heat Rate: 19369.0 Btu/kWh
Usable Heat: 13299.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 4.60 cents/kWh
Initial Fuel Cost: 2.58 $/MMBtu
Boiler Efficiency: 80.00 %
Elec. Used On Site: 79.00 %
Electricity Sale Price: 2.54 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh
Labour Savings: 325.0 $(1000)/year

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1353.8	1408.0	1464.3	1522.9	1583.8	1647.1	1717.9	1791.8	1868.9	1949.2
Electricity Sold:			198.3	207.3	216.6	226.3	236.5	247.2	259.5	272.5	286.1	300.4
Thermal Use:			1464.8	1495.7	1531.2	1593.0	1659.5	1721.3	1712.6	1703.7	1694.8	1686.0
TOTAL REVENUES: $(1000)			3017.0	3110.9	3212.0	3342.2	3479.7	3615.6	3690.0	3768.0	3849.8	3935.7
EXPENSE												
Fuel:			1724.1	1760.5	1802.2	1875.0	1953.2	2026.1	2015.7	2005.3	1994.8	1984.5
O&M:			97.4	101.8	106.3	111.1	116.1	121.4	127.4	133.8	140.5	147.5
Labour Savings:			-372.3	-389.1	-406.6	-424.9	-444.0	-464.0	-487.2	-511.5	-537.1	-563.9
Insurance:			37.9	39.6	41.4	43.2	45.2	47.2	49.6	52.1	54.7	57.4
TOTAL EXPENSES: $(1000)			1487.1	1512.8	1543.4	1604.6	1670.6	1730.7	1705.6	1679.6	1652.9	1625.4
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1529.9	1598.1	1668.7	1737.7	1809.2	1884.9	1984.4	2088.4	2196.9	2310.2
[Depreciation]:(Class 34)	426.3	1492.2	1705.3	639.5								
[Depreciation]:Class 3(4%)	7.6	18.6	17.9	17.2	16.5	15.8	15.2	14.6	14.0	13.5	12.9	12.4
TAXES: 44.34 percent	-192.4	-669.9	-85.7	417.4	732.6	763.5	795.4	829.3	873.7	920.0	968.4	1018.9
PROFIT(After Tax):$(1000)	192.4	669.9	1615.6	1180.7	936.1	974.2	1013.7	1055.6	1110.8	1168.4	1228.5	1291.4
PROFIT PRESENT VALUE (After Tax):$(1000)	192.4	592.8	1265.2	818.3	574.1	528.8	486.9	448.7	417.8	388.9	361.9	336.7
CUMULATIVE CASH FLOW (NPV): $(1000)	-1702.4	-3874.7	-2259.1	-1078.4	-142.3	831.9	1845.6	2901.2	4012.0	5180.3	6408.8	7700.2
(based on profit NPV)	-1702.4	-3624.8	-2359.6	-1541.3	-967.2	-438.4	48.5	497.2	915.0	1304.0	1665.9	2002.5

SIMPLE PAYBACK: 3.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 6.9 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 24.77%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.10C Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:

Installed Cost:	7681 $(1000)			Elec. Purchase Price:	4.60 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.58 $/MMBtu
Down Payment	7681 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	37.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	94.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	93.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%			Labour Savings:	325.0 $(1000)/year

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1381.5	1436.7	1494.2	1554.0	1616.1	1680.8	1753.1	1828.4	1907.1	1989.1
Electricity Sold:			1296.5	1354.8	1415.8	1479.5	1546.0	1615.6	1696.4	1781.2	1870.3	1963.8
Thermal Use:			1201.9	1227.3	1256.3	1307.1	1361.6	1412.4	1405.2	1397.9	1390.6	1383.4
TOTAL REVENUES: $(1000)			3879.8	4018.8	4166.3	4340.6	4523.8	4708.8	4854.7	5007.5	5168.0	5336.3
EXPENSE												
Fuel:			2165.4	2211.1	2263.5	2354.9	2453.1	2544.6	2531.6	2518.5	2505.4	2492.4
O&M:			212.2	221.7	231.7	242.1	253.0	264.4	277.6	291.5	306.1	321.4
Labour Savings:			-372.3	-389.1	-406.6	-424.9	-444.0	-464.0	-487.2	-511.5	-537.1	-563.9
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2066.7	2108.0	2155.7	2242.3	2335.4	2421.7	2402.5	2382.9	2363.0	2342.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1813.1	1910.8	2010.6	2098.2	2188.3	2287.1	2452.1	2624.6	2804.9	2993.4
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-435.0	375.1	879.6	919.0	959.4	1003.6	1077.2	1154.1	1234.4	1318.3
PROFIT(After Tax):$(1000)	312.0	1086.2	2248.1	1535.7	1131.0	1179.3	1229.0	1283.5	1374.9	1470.5	1570.5	1675.0
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1760.6	1064.3	693.6	640.1	590.3	545.6	517.2	489.5	462.7	436.7
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-4034.7	-2499.0	-1368.0	-188.8	1040.2	2323.7	3698.7	5169.2	6739.7	8414.7
(based on profit NPV)	-2760.4	-5877.6	-4117.0	-3052.6	-2359.0	-1719.0	-1128.7	-583.1	-65.9	423.6	886.3	1323.0

SIMPLE PAYBACK: 4.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.14%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.10D

Prime Mover: Solar "Mars" gas turbine
with supplemental firing

ASSUMPTIONS:

Installed Cost:	9114 $(1000)			Elec. Purchase Price:	4.60 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.58 $/MMBtu
Down Payment	9114 $(1000)	Gross Heat Rate:	19409.0 Btu/kWh	Boiler Efficiency:	80.00 %
Loan Terms:		Usable Heat:	13484.0 Btu/kWh	Elec. Used On Site:	37.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	2.54 cents/kWh
Term	6.0 Years	Electrical:	93.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	92.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%			Labour Savings:	325.0 $(1000)/year

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1366.8	1421.5	1478.3	1537.5	1599.0	1662.9	1734.4	1809.0	1886.8	1967.9
Electricity Sold:			1282.7	1340.4	1400.7	1463.7	1529.6	1598.4	1678.4	1762.3	1850.4	1942.9
Thermal Use:			3199.4	3266.9	3344.3	3479.4	3624.5	3759.7	3740.5	3721.1	3701.7	3682.5
TOTAL REVENUES: $(1000)			5848.8	6028.7	6223.3	6480.6	6753.1	7021.0	7153.3	7292.3	7438.9	7593.3
EXPENSE												
Fuel:			3724.2	3802.8	3892.9	4050.2	4219.1	4376.5	4354.1	4331.5	4309.0	4286.6
O&M:			209.9	219.4	229.2	239.6	250.3	261.6	274.7	288.4	302.8	318.0
Labour Savings:			-372.3	-389.1	-406.6	-424.9	-444.0	-464.0	-487.2	-511.5	-537.1	-563.9
Insurance:			72.9	76.2	79.6	83.2	86.9	90.9	95.4	100.2	105.2	110.4
TOTAL EXPENSES: $(1000)			3634.7	3709.3	3795.2	3948.1	4112.4	4265.0	4237.1	4208.6	4179.9	4151.0
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			2214.1	2319.4	2428.1	2532.5	2640.7	2756.1	2916.2	3083.8	3259.0	3442.3
[Depreciation]:(Class 34)	820.3	2870.9	3281.0	1230.4								
[Depreciation]:Class 3(4%)	14.6	35.9	34.4	33.1	31.7	30.5	29.2	28.1	27.0	25.9	24.8	23.8
TAXES: 44.34 percent	-370.2	-1288.9	-488.4	468.2	1062.6	1109.4	1157.9	1209.6	1281.1	1355.9	1434.0	1515.7
PROFIT(After Tax):$(1000)	370.2	1288.9	2702.4	1851.2	1365.6	1423.1	1482.8	1546.5	1635.1	1727.9	1825.0	1926.5
PROFIT PRESENT VALUE (After Tax):$(1000)	370.2	1140.6	2116.4	1283.0	837.5	772.4	712.2	657.4	615.1	575.2	537.6	502.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-3275.4	-7455.0	-4752.5	-2901.3	-1535.7	-112.6	1370.1	2916.6	4551.7	6279.6	8104.6	10031.1
(based on profit NPV)	-3275.4	-6974.1	-4857.7	-3574.7	-2737.2	-1964.8	-1252.6	-595.3	19.8	595.0	1132.6	1634.9

SIMPLE PAYBACK: 4.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.38%
(Based on 10 Years)

3.11 GROUP 28 - CHEMICALS AND ALLIED PRODUCTS

a) Background Plant Data

The plant operates 8,760 hours per year. Electricity is received from the Utility at 44 kV and distributed at 13.8 kV.

Steam generated by the cogeneration system should be at 450 psig and 630°F. The average steam demand throughout the year is 500,000 lbs/hr with the peak demand 20% higher.

The electrical consumption and demand data by month are provided in the following table.

Month	Peak (kW)	Power Factor	Corrected Peak (kW)	Consumption (kWh)	Average Demand (kW)
January	6,511.7	84.7	6,921.8	4,428,141	5,951
February	6,632.6	83.8	7,121.1	4,286,352	6,158
March	7,899.4	84.5	8,417.0	4,449,702	5,981
April	7,052.6	85.6	7,417.2	4,504,285	6,256
May	7,274.4	87.7	7,466.4	4,649,659	6,250
June	7,361.8	87.4	7,579.1	4,847,106	6,732
July	8,672.2	86.5	9,018.2	5,807,582	7,806
August	8,510.9	86.3	8,879.1	5,906,941	7,536
September	10,833.0	92.8	10,883.0	6,376,954	8,857
October	10,600.8	91.1	10,600.8	6,141,959	8,255
November	6,847.7	84.4	7,301.4	4,137,105	5,746
December	7,136.6	85.2	7,540.0	4,337,545	5,830

b) Cogeneration Scenarios

Because of the very high thermal demand throughout the year there is no question about being able to realize a very high system load factor even with supplemental firing. For this reason each scenario has been selected with supplemental firing to maximize the financial performance. Thus, the scenarios are selected to demonstrate the financial performance differences for various sizes of generators.

- **Scenario 3.11A** includes the installation of a packaged natural gas fired turbine generator set with a heat recovery boiler. The nominal rating of the system is 8,589 kW. The boiler produces 102,300 lbs/hr of steam at 450 psig and 630°F. Surplus electricity is sold to the Utility.
- **Scenario 3.11B** is similar to 3.11A but with a nominal generator rating of 15,739 kW with steam produced at the rate of 245,100 lbs/hr.

- **Scenario 3.11C** is similar to 3.11A but with a nominal generator rating of 21,480 kW and steam produced at the rate of 184,300 lbs/hr.
- **Scenario 3.11D** is similar to 3.11A but with a nominal generator rating of 26,840 kW and steam produced at the rate of 342,400 lbs/hr.
- **Scenario 3.11E** is similar to 3.11A but with a nominal generator rating of 39,240 kW and steam produced at the rate of 385,100 lbs/hr.
- **Scenario 3.11F** is similar to 3.11A but with a nominal generator rating of 85,140 kW and steam produced at the rate of 547,800 lbs/hr.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.11A

Prime Mover: Solar "Mars" gas turbine with supplemental firing

ASSUMPTIONS:

Installed Cost: 9114 $(1000)
Loan Amount: 0 $(1000)
Down Payment 9114 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 8589.0 kW
Gross Heat Rate: 19409.0 Btu/kWh
Usable Heat: 13484.0 Btu/kWh
Load Factors:
Electrical: 99.0 %
Thermal: 98.0 %

Elec. Purchase Price: 3.84 cents/kWh
Initial Fuel Cost: 2.55 $/MMBtu
Boiler Efficiency: 83.00 %
Elec. Used On Site: 79.00 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2593.3	2697.0	2804.9	2917.1	3033.8	3155.2	3290.8	3432.3	3579.9	3733.9
Electricity Sold:			673.7	704.1	735.8	768.9	803.5	839.6	881.6	925.7	972.0	1020.6
Thermal Use:			3246.7	3315.2	3393.7	3530.8	3678.1	3815.3	3795.8	3776.1	3756.4	3736.9
TOTAL REVENUES: $(1000)			6513.7	6716.3	6934.4	7216.8	7515.3	7810.0	7968.2	8134.1	8308.3	8491.3
EXPENSE												
Fuel:			3918.4	4001.1	4095.9	4261.4	4439.1	4604.6	4581.2	4557.3	4533.6	4510.1
O&M:			223.5	233.5	244.0	255.0	266.5	278.5	292.4	307.0	322.4	338.5
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			72.9	76.2	79.6	83.2	86.9	90.9	95.4	100.2	105.2	110.4
TOTAL EXPENSES: $(1000)			4214.8	4310.8	4419.5	4599.6	4792.5	4974.0	4969.0	4964.5	4961.2	4959.0
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			2298.9	2405.5	2514.9	2617.2	2722.8	2836.1	2999.3	3169.5	3347.1	3532.3
[Depreciation]:(Class 34)	820.3	2870.9	3281.0	1230.4								
[Depreciation]:Class 3(4%)	14.6	35.9	34.4	33.1	31.7	30.5	29.2	28.1	27.0	25.9	24.8	23.6
TAXES: 44.34 percent	-370.2	-1288.9	-450.7	506.4	1101.0	1147.0	1194.3	1245.1	1317.9	1393.9	1473.1	1555.7
PROFIT(After Tax):$(1000)	370.2	1288.9	2749.7	1899.1	1413.8	1470.3	1528.5	1591.0	1681.3	1775.6	1874.0	1976.7
PROFIT PRESENT VALUE (After Tax):$(1000)	370.2	1140.6	2153.4	1316.2	867.1	798.0	734.2	676.3	632.5	591.1	552.1	515.3
CUMULATIVE CASH FLOW (NPV): $(1000)	-3275.4	-7455.0	-4705.3	-2806.2	-1392.3	77.9	1606.4	3197.4	4878.8	6654.4	8528.4	10505.1
(based on profit NPV)	-3275.4	-6974.1	-4820.7	-3504.6	-2637.4	-1839.4	-1105.3	-429.0	203.5	794.6	1346.6	1861.9

SIMPLE PAYBACK: 4.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.09%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

```
PLANT CODE NO..MBEL-3.11B        Prime Mover:      Solar "Jupiter" gas turbine
                                 with supplemental firing
ASSUMPTIONS:
Installed Cost:16065 $(1000)                                   Elec. Purchase Price:        3.84 cents/kWh
Loan Amount:        0 $(1000)    Size:             15739.0 kW  Initial Fuel Cost:           2.55 $/MMBtu
Down Payment   16065 $(1000)     Gross Heat Rate:  23833.0 Btu/kWh  Boiler Efficiency:     83.00 %
Loan Terms:                      Usable Heat:      17625.0 Btu/kWh  Elec. Used On Site:    44.00 %
      Int.      12.0 %           Load Factors:                 Electricity Sale Price:      3.76 cents/kWh
      Term       6.0 Years          Electrical:       99.0 %   Construction Period:         2.00 year(s)
Discount Rate:  13.0%               Thermal:          98.0 %   O&M Charge:                  0.30 cents/kWh
IRR Guess:      40.0%
======================================================================================================================

YEAR:                          1989     1990     1991     1992     1993     1994     1995     1996     1997     1998     1999     2000

REVENUE
      Displaced Electricity:                   2646.8   2752.6   2862.7   2977.2   3096.3   3220.2   3358.7   3503.1   3653.7   3810.8
      Electricity Sold:                        3292.3   3440.5   3595.3   3757.1   3926.1   4102.8   4308.0   4523.4   4749.5   4987.0
      Thermal Use:                             7776.4   7940.5   8128.7   8457.1   8809.8   9138.4   9091.8   9044.5   8997.5   8950.7
TOTAL REVENUES: $(1000)                       13715.5  14133.6  14586.7  15191.4  15832.2  16461.4  16758.4  17070.9  17400.7  17748.5

EXPENSE
      Fuel:                                    8816.9   9003.0   9216.3   9588.7   9988.5  10361.1  10308.3  10254.6  10201.3  10148.3
      O&M:                                      409.5    427.9    447.2    467.3    488.3    510.3    535.8    562.6    590.7    620.3
      P&I:                                        0.0      0.0      0.0      0.0      0.0      0.0
      Insurance:                                128.5    134.3    140.3    146.7    153.3    160.2    168.2    176.6    185.4    194.7
TOTAL EXPENSES: $(1000)                        9354.9   9565.2   9803.8 10202.[illegible] 10630.1  11031.5  11012.2  10993.8  10977.5  10963.2

TAX INCENTIVES:

PROFIT (Pre Tax):$(1000)                       4360.6   4568.4   4782.9   4988.8   5202.1   5429.8   5746.2   6077.1   6423.2   6785.3

[Depreciation]:(Class 34)     1445.9   5060.5   5783.4   2168.8

[Depreciation]:Class 3(4%)      25.7     63.2     60.7     58.3     55.9     53.7     51.6     49.5     47.5     45.6     43.8     42.0

TAXES:   44.34 percent        -652.5  -2271.9   -657.8   1038.2   2095.9   2188.2   2283.8   2385.6   2526.8   2674.4   2828.6   2990.0

PROFIT(After Tax):$(1000)      652.5   2271.9   5018.4   3530.3   2687.0   2800.6   2918.4   3044.2   3219.4   3402.7   3594.6   3795.3

PROFIT PRESENT VALUE           652.5   2010.5   3930.1   2446.6   1648.0   1520.0   1401.7   1294.0   1211.0   1132.7   1058.9    989.4
(After Tax):$(1000)
CUMULATIVE CASH FLOW         -5773.5 -13140.7  -8122.3  -4592.0  -1905.1    895.5   3813.9   6858.1  10077.5  13480.2  17074.8  20870.1
(NPV): $(1000)
(based on profit NPV)        -5773.5 -12293.1  -8363.0  -5916.3  -4268.4  -2748.3  -1346.6    -52.6   1158.4   2291.1   3350.0   4339.5
======================================================================================================================
SIMPLE PAYBACK:       3.9 years          INTERNAL RATE OF RETURN:    20.85%
(Based on 10 Year After-Tax Average)     (Based on 10 Years)
DISCOUNTED PAYBACK:   7.9 years
(Based on 10 Year After-Tax Average)
```

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.11C

Prime Mover: GE LM2500 gas turbine with supplemental firing

ASSUMPTIONS:

Installed Cost: 20374 $(1000)
Loan Amount: 0 $(1000)
Down Payment 20374 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 21480.0 kW
Gross Heat Rate: 15974.0 Btu/kWh
Usable Heat: 9712.0 Btu/kWh
Load Factors:
Electrical: 95.0 %
Thermal: 94.0 %

Elec. Purchase Price: 3.84 cents/kWh
Initial Fuel Cost: 2.55 $/MMBtu
Boiler Efficiency: 83.00 %
Elec. Used On Site: 32.00 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2520.9	2621.7	2726.6	2835.7	2949.1	3067.1	3199.0	3336.5	3480.0	3629.6
Electricity Sold:			5235.6	5471.2	5717.4	5974.7	6243.6	6524.5	6850.8	7193.3	7553.0	7930.6
Thermal Use:			5609.4	5727.8	5863.5	6100.4	6354.8	6591.8	6558.2	6524.1	6490.2	6456.5
TOTAL REVENUES: $(1000)			13366.0	13820.8	14307.6	14910.8	15547.5	16183.5	16607.9	17053.9	17523.1	18016.7
EXPENSE												
Fuel:			7739.2	7902.5	8089.8	8416.6	8767.6	9094.7	9048.3	9001.2	8954.4	8907.8
O&M:			536.3	560.4	585.6	612.0	639.5	668.3	701.7	736.8	773.6	812.3
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			163.0	170.3	178.0	186.0	194.4	203.1	213.3	223.9	235.1	246.9
TOTAL EXPENSES: $(1000)			8438.5	8633.3	8853.4	9214.6	9601.5	9966.1	9963.2	9961.9	9963.2	9967.1
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			4927.5	5187.5	5454.1	5696.2	5946.0	6217.4	6644.7	7092.0	7560.0	8049.6
[Depreciation]:(Class 34)	1833.7	6417.8	7334.6	2750.5								
[Depreciation]:Class 3(4%)	32.6	80.2	77.0	73.9	70.9	68.1	65.4	62.8	60.3	57.8	55.5	53.3
TAXES: 44.34 percent	-827.5	-2881.2	-1101.5	1047.8	2386.9	2495.5	2607.5	2729.0	2919.5	3118.9	3327.5	3545.6
PROFIT(After Tax):$(1000)	827.5	2881.2	6028.9	4139.7	3067.2	3200.7	3338.5	3488.4	3725.2	3973.1	4232.5	4504.1
PROFIT PRESENT VALUE (After Tax):$(1000)	827.5	2549.7	4721.5	2869.0	1881.2	1737.2	1603.6	1482.8	1401.3	1322.6	1246.8	1174.2
CUMULATIVE CASH FLOW	-7322.1	-16665.3	-10636.3	-6496.6	-3429.4	-228.7	3109.8	6598.3	10323.4	14296.5	18529.0	23033.0
(NPV): $(1000) (based on profit NPV)	-7322.1	-15590.4	-10868.9	-7999.8	-6118.6	-4381.4	-2777.9	-1295.1	106.2	1428.7	2675.6	3849.6

SIMPLE PAYBACK: 4.2 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.61%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO. .MBEL-3.11D

Prime Mover: GE LM5001 gas turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost: 22235 $(1000)
Loan Amount: 0 $(1000)
Down Payment 22235 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 26840.0 kW
Gross Heat Rate: 21311.0 Btu/kWh
Usable Heat: 14441.0 Btu/kWh
Load Factors:
Electrical: 95.0 %
Thermal: 94.0 %

Elec. Purchase Price: 3.84 cents/kWh
Initial Fuel Cost: 2.55 $/MMBtu
Boiler Efficiency: 83.00 %
Elec. Used On Site: 26.00 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2559.3	2661.7	2768.2	2878.9	2994.1	3113.8	3247.7	3387.4	3533.0	3685.0
Electricity Sold:			7119.3	7439.7	7774.5	8124.3	8489.9	8872.0	9315.6	9781.4	10270.4	10783.9
Thermal Use:			10422.1	10642.0	10894.2	11334.4	11807.0	12247.4	12184.9	12121.6	12058.5	11995.8
TOTAL REVENUES: $(1000)			20100.8	20743.4	21436.9	22337.6	23291.0	24233.2	24748.2	25290.3	25862.0	26464.7
EXPENSE												
Fuel:			12901.4	13173.6	13485.8	14030.6	14615.7	15160.9	15083.6	15005.1	14927.1	14849.5
O&M:			670.1	700.2	731.8	764.7	799.1	835.1	876.8	920.6	966.7	1015.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			177.9	185.9	194.2	203.0	212.1	221.7	232.8	244.4	256.6	269.4
TOTAL EXPENSES: $(1000)			13749.3	14059.7	14411.8	14998.3	15626.9	16217.6	16193.1	16170.2	16150.4	16133.9
TAX INCENTIVES:												
PROFIT (Pre Tax): $(1000)			6351.4	6683.7	7025.1	7339.3	7664.1	8015.6	8555.1	9120.2	9711.6	10330.8
[Depreciation]: (Class 34)	2001.2	7004.0	8004.6	3001.7								
[Depreciation]: Class 3(4%)	35.6	87.5	84.0	80.7	77.4	74.3	71.4	68.5	65.8	63.1	60.6	58.2
TAXES: 44.34 percent	-903.1	-3144.4	-770.3	1596.8	3080.6	3221.3	3366.6	3523.7	3764.2	4015.9	4279.3	4554.9
PROFIT (After Tax): $(1000)	903.1	3144.4	7121.7	5086.9	3944.5	4118.0	4297.5	4491.9	4790.9	5104.3	5432.4	5775.9
PROFIT PRESENT VALUE (After Tax): $(1000)	903.1	2782.6	5577.3	3525.5	2419.2	2235.1	2064.2	1909.3	1802.2	1699.1	1600.3	1505.8
CUMULATIVE CASH FLOW (NPV): $(1000)	-7990.9	-18187.5	-11065.8	-5978.9	-2034.4	2083.6	6381.0	10872.9	15663.8	20768.1	26200.5	31976.4
(based on profit NPV)	-7990.9	-17014.5	-11437.1	-7911.7	-5492.4	-3257.3	-1193.2	716.1	2518.3	4217.4	5817.7	7323.5

SIMPLE PAYBACK: 3.6 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.5 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 22.32%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.11E

Prime Mover: GE LM6001 gas turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost: 29900 $(1000)
Loan Amount: 0 $(1000)
Down Payment 29900 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 39240.0 kW
Gross Heat Rate: 17584.0 Btu/kWh
Usable Heat: 11110.0 Btu/kWh
Load Factors:
Electrical: 95.0 %
Thermal: 94.0 %

Elec. Purchase Price: 3.84 cents/kWh
Initial Fuel Cost: 2.55 $/MMBtu
Boiler Efficiency: 85.00 %
Elec. Used On Site: 17.50 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2518.5	2619.2	2724.0	2833.0	2946.3	3064.1	3195.9	3333.3	3476.6	3626.1
Electricity Sold:			11604.0	12126.2	12671.9	13242.1	13838.0	14460.7	15183.7	15942.9	16740.1	17577.1
Thermal Use:			11446.6	11688.2	11965.2	12448.6	12967.7	13451.4	13382.8	13313.2	13243.9	13175.1
TOTAL REVENUES: $(1000)			25569.1	26433.6	27361.0	28523.6	29751.9	30976.2	31762.4	32589.4	33460.6	34378.3
EXPENSE												
Fuel:			15563.1	15891.5	16268.1	16925.4	17631.1	18288.8	18195.5	18100.9	18006.8	17913.1
O&M:			979.7	1023.8	1069.8	1118.0	1168.3	1220.8	1281.9	1346.0	1413.3	1483.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			239.2	250.0	261.2	273.0	285.3	298.1	313.0	328.6	345.1	362.3
TOTAL EXPENSES: $(1000)			16782.0	17165.2	17599.2	18316.3	19084.7	19807.7	19790.4	19775.5	19765.1	19759.4
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			8787.2	9268.4	9761.9	10207.3	10667.3	11168.5	11972.0	12813.9	13695.5	14618.9
[Depreciation]:(Class 34)	2691.0	9418.5	10764.0	4036.5								
[Depreciation]:Class 3(4%)	47.8	117.7	113.0	108.5	104.1	100.0	96.0	92.1	88.4	84.9	81.5	78.2
TAXES: 44.34 percent	-1214.4	-4228.3	-926.6	2271.7	4282.2	4481.6	4687.3	4911.3	5269.2	5644.0	6036.5	6447.3
PROFIT(After Tax):$(1000)	1214.4	4228.3	9713.8	6996.6	5479.6	5725.7	5980.0	6257.2	6702.8	7169.9	7659.1	8171.6
PROFIT PRESENT VALUE (After Tax):$(1000)	1214.4	3741.9	7607.3	4849.0	3360.8	3107.7	2872.3	2659.7	2521.3	2386.7	2256.3	2130.3
CUMULATIVE CASH FLOW (NPV): $(1000)	-10745.6	-24457.3	-14743.5	-7746.8	-2267.2	3458.5	9438.5	15695.7	22398.5	29568.4	37227.4	45399.0
(based on profit NPV)	-10745.6	-22879.8	-15272.5	-10423.5	-7062.7	-3955.0	-1082.7	1577.0	4098.3	6485.0	8741.3	10871.6

SIMPLE PAYBACK: 3.5 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 7.2 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 23.14%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.11F Prime Mover: GE LM7001 gas turbine

ASSUMPTIONS:

Installed Cost:	48000 $(1000)			Elec. Purchase Price:	3.84 cents/kWh
Loan Amount:	0 $(1000)	Size:	85140.0 kW	Initial Fuel Cost:	2.55 $/MMBtu
Down Payment	48000 $(1000)	Gross Heat Rate:	13544.0 Btu/kWh	Boiler Efficiency:	83.00 %
Loan Terms:		Usable Heat:	7284.0 Btu/kWh	Elec. Used On Site:	8.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	95.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	94.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			2498.0	2597.9	2701.9	2809.9	2922.3	3039.2	3169.9	3306.2	3448.4	3596.7
Electricity Sold:			28076.7	29340.2	30660.5	32040.2	33482.0	34988.7	36738.1	38575.0	40503.8	42529.0
Thermal Use:			16675.5	17027.4	17430.9	18135.1	18891.4	19596.0	19496.1	19394.7	19293.8	19193.5
TOTAL REVENUES: $(1000)			47250.3	48965.5	50793.3	52985.3	55295.7	57623.9	59404.1	61276.0	63246.0	65319.2
EXPENSE												
Fuel:			26009.4	26558.2	27187.6	28286.0	29465.5	30564.6	30408.7	30250.6	30093.3	29936.8
O&M:			2125.6	2221.3	2321.2	2425.7	2534.8	2648.9	2781.3	2920.4	3066.4	3219.7
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			384.0	401.3	419.3	438.2	457.9	478.5	502.5	527.6	554.0	581.7
TOTAL EXPENSES: $(1000)			28519.0	29180.7	29928.2	31149.9	32458.3	33692.0	33692.5	33698.6	33713.7	33738.2
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			18731.3	19784.7	20865.1	21835.4	22837.4	23931.9	25711.6	27577.4	29532.3	31581.0
[Depreciation]:(Class 34)	4320.0	15120.0	17280.0	6480.0								
[Depreciation]:Class 3(4%)	76.8	188.9	181.4	174.1	167.2	160.5	154.0	147.9	142.0	136.3	130.8	125.6
TAXES: 44.34 percent	-1949.5	-6788.0	563.1	5822.1	9177.5	9610.7	10057.8	10545.8	11337.6	12167.4	13036.6	13947.3
PROFIT(After Tax):$(1000)	1949.5	6788.0	18168.2	13962.6	11687.6	12224.7	12779.6	13386.1	14374.0	15410.0	16495.7	17633.7
PROFIT PRESENT VALUE (After Tax):$(1000)	1949.5	6007.1	14228.4	9676.8	7168.2	6635.1	6138.3	5689.9	5406.9	5129.8	4859.4	4597.1
CUMULATIVE CASH FLOW (NPV): $(1000)	-17250.5	-39262.5	-21094.3	-7131.7	4556.0	16780.7	29560.3	42946.4	57320.4	72730.4	89226.1	106859.8
(based on profit NPV)	-17250.5	-36730.1	-22501.8	-12825.0	-5656.7	978.4	7116.6	12806.5	18213.5	23343.2	28202.7	32799.7

SIMPLE PAYBACK: 2.7 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 5.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 30.46%
(Based on 10 Years)

3.12 GROUP 20 - FOOD AND KINDRED PRODUCTS

a) Background Plant Data

This plant operates on a 24 hour day, 7 days a week schedule and shuts down for 2 weeks a year for maintenance.

The electrical demand was analyzed for summer and winter months. The results are generalized below.

Period	**Peak Demand** (kW)	**Average Demand** (kW)
Summer	3,200	2,000
Winter	3,400	2,525

Summer average steam load: 8,900 lbs/hr
Winter average steam load: 14,600 lbs/hr

b) Cogeneration Scenarios

- **Scenario 3.12A** involves the installation of a packaged natural gas fired turbine/generator set and heat recovery boiler. The nominal electrical output of the system is 3,743 kW. Steam is generated at a rate of 23,600 lbs/hr. Excess electricity is sold to the Utility.
- **Scenario 3.12B** is the same as 3.12A except that the heat recovery boiler can be supplementally fired to increase steam output to 39,800 lbs/hr.
- **Scenario 3.12C** is similar to 3.12A except a larger turbine/generator set and boiler are used. The nominal electrical output is 8,589 kW and steam output is 42,700 lbs/hr.
- **Scenario 3.12D** is the same as 3.12C except that the turbine firing rate is controlled to more closely track the varying thermal demand.
- **Scenario 3.12E** is identical to 3.12C except that the operation commits to a ten year electric sell-back arrangement with the Electric Utility at a fixed rate of $0.0494/kWh. This rate does not change over the term of the agreement although the electric purchase rate is allowed to escalate normally.

c) Summary of Results

Separate "Cogeneration System Cash Flow Analysis" sheets follow for each scenario. The results are also included in the Section 5.1 "Financial Analysis Results Matrix".

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.12A   Prime Mover: Solar "Centaur Type H" gas turbine

ASSUMPTIONS:

Installed Cost:	4074 $(1000)			Elec. Purchase Price:	4.76 cents/kWh
Loan Amount:	0 $(1000)	Size:	3743.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	4074 $(1000)	Gross Heat Rate:	12530.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	6347.0 Btu/kWh	Elec. Used On Site:	63.00 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	96.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	95.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1083.3	1126.7	1171.7	1218.6	1267.3	1318.0	1374.7	1433.8	1495.5	1559.8
Electricity Sold:			501.6	524.2	547.8	572.5	598.2	625.1	656.4	689.2	723.7	759.9
Thermal Use:			750.9	766.7	784.9	816.6	850.6	882.4	877.9	873.3	868.8	864.2
TOTAL REVENUES: $(1000)			2335.8	2417.6	2504.4	2607.6	2716.2	2825.5	2909.0	2996.3	3087.9	3183.9
EXPENSE												
Fuel:			1186.4	1211.4	1240.1	1290.2	1344.0	1394.1	1387.0	1379.8	1372.6	1365.5
O&M:			94.4	98.7	103.1	107.8	112.6	117.7	123.6	129.7	136.2	143.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			32.6	34.1	35.6	37.2	38.9	40.6	42.6	44.8	47.0	49.4
TOTAL EXPENSES: $(1000)			1313.4	1344.1	1378.8	1435.2	1495.5	1552.4	1553.2	1554.3	1555.9	1557.9
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1022.4	1073.4	1125.6	1172.5	1220.7	1273.1	1355.7	1442.0	1532.0	1626.0
[Depreciation]:(Class 34)	366.7	1283.3	1466.6	550.0								
[Depreciation]:Class 3(4%)	6.5	16.0	15.4	14.8	14.2	13.6	13.1	12.6	12.0	11.6	11.1	10.7
TAXES: 44.34 percent	-165.5	-576.1	-203.8	225.5	492.8	513.8	535.5	558.9	595.8	634.3	674.4	716.2
PROFIT(After Tax):$(1000)	165.5	576.1	1226.2	847.9	632.8	658.6	685.2	714.2	759.9	807.7	857.6	909.7
PROFIT PRESENT VALUE (After Tax):$(1000)	165.5	509.8	960.3	587.6	388.1	357.5	329.1	303.6	285.9	268.9	252.7	237.2
CUMULATIVE CASH FLOW (NPV): $(1000)	-1464.1	-3332.4	-2106.2	-1258.3	-625.5	33.2	718.4	1432.6	2192.5	3000.3	3857.9	4767.6
(based on profit NPV)	-1464.1	-3117.5	-2157.2	-1569.5	-1181.4	-823.9	-494.8	-191.2	94.6	363.5	616.2	853.3

SIMPLE PAYBACK: 4.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.20%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.12B

Prime Mover: Solar "Centaur Type H" gas turbine
with supplemental firing

ASSUMPTIONS:
Installed Cost: 4737 $(1000)
Loan Amount: 0 $(1000)
Down Payment 4737 $(1000)
Loan Terms:
Int. 12.0 %
Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 3743.0 kW
Gross Heat Rate: 16821.0 Btu/kWh
Usable Heat: 10709.0 Btu/kWh
Load Factors:
Electrical: 96.0 %
Thermal: 95.0 %

Elec. Purchase Price: 4.76 cents/kWh
Initial Fuel Cost: 2.83 $/MMBtu
Boiler Efficiency: 79.20 %
Elec. Used On Site: 63.00 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1083.3	1126.7	1171.7	1218.6	1267.3	1318.0	1374.7	1433.8	1495.5	1559.8
Electricity Sold:			501.6	524.2	547.8	572.5	598.2	625.1	656.4	689.2	723.7	759.9
Thermal Use:			1266.9	1293.6	1324.3	1377.8	1435.2	1488.8	1481.2	1473.5	1465.8	1458.2
TOTAL REVENUES: $(1000)			2851.9	2944.5	3043.8	3168.8	3300.8	3431.9	3512.3	3596.5	3685.0	3777.8
EXPENSE												
Fuel:			1592.6	1626.2	1664.8	1732.0	1804.3	1871.6	1862.0	1852.3	1842.7	1833.1
O&M:			94.4	98.7	103.1	107.8	112.6	117.7	123.6	129.7	136.2	143.0
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			37.9	39.6	41.4	43.2	45.2	47.2	49.6	52.1	54.7	57.4
TOTAL EXPENSES: $(1000)			1725.0	1764.5	1809.3	1883.0	1962.1	2036.5	2035.2	2034.1	2033.6	2033.6
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1126.9	1180.0	1234.5	1285.8	1338.7	1395.5	1477.1	1562.4	1651.4	1744.3
[Depreciation]:(Class 34)	426.3	1492.2	1705.3	639.5								
[Depreciation]:Class 3(4%)	7.6	18.6	17.9	17.2	16.5	15.8	15.2	14.6	14.0	13.5	12.9	12.4
TAXES: 44.34 percent	-192.4	-669.9	-264.4	232.0	540.1	563.1	586.8	612.3	648.7	686.8	726.5	767.9
PROFIT(After Tax):$(1000)	192.4	669.9	1391.3	947.9	694.4	722.7	751.9	783.2	826.4	875.6	924.9	976.4
PROFIT PRESENT VALUE (After Tax):$(1000)	192.4	592.8	1089.6	657.0	425.9	392.2	361.1	332.9	311.6	291.5	272.5	254.5
CUMULATIVE CASH FLOW (NPV): $(1000)	-1702.4	-3874.7	-2483.4	-1535.5	-841.0	-116.3	633.5	1416.7	2245.1	3120.7	4045.5	5021.9
(based on profit NPV)	-1702.4	-3624.8	-2535.2	-1878.2	-1452.3	-1060.1	-698.9	-366.0	-54.4	237.0	509.5	764.0

SIMPLE PAYBACK: 4.4 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.8 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 17.88%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.12C   Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:

Installed Cost: 7681 $(1000)
Loan Amount: 0 $(1000)
Down Payment 7681 $(1000)
Loan Terms:
    Int. 12.0 %
    Term 6.0 Years
Discount Rate: 13.0%
IRR Guess: 40.0%

Size: 8589.0 kW
Gross Heat Rate: 11165.0 Btu/kWh
Usable Heat: 5011.0 Btu/kWh
Load Factors:
    Electrical: 96.0 %
    Thermal: 87.0 %

Elec. Purchase Price: 4.76 cents/kWh
Initial Fuel Cost: 2.83 $/MMBtu
Boiler Efficiency: 79.20 %
Elec. Used On Site: 27.40 %
Electricity Sale Price: 3.76 cents/kWh
Construction Period: 2.00 year(s)
O&M Charge: 0.30 cents/kWh

YEAR:		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1081.2	1124.4	1169.4	1216.2	1264.8	1315.4	1372.0	1430.9	1492.5	1556.7
Electricity Sold:			2258.7	2360.3	2466.5	2577.5	2693.5	2814.7	2955.4	3103.2	3258.4	3421.3
Thermal Use:			1245.8	1272.0	1302.2	1354.8	1411.3	1463.9	1456.5	1448.9	1441.4	1433.9
TOTAL REVENUES: $(1000)			4585.6	4756.8	4938.1	5148.5	5369.6	5594.0	5783.9	5983.1	6192.2	6411.8
EXPENSE												
Fuel:			2425.7	2476.9	2535.6	2638.1	2748.1	2850.6	2836.0	2821.3	2806.6	2792.0
O&M:			216.7	226.4	236.6	247.3	258.4	270.0	283.5	297.7	312.6	328.2
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2703.9	2767.6	2839.4	2955.5	3079.8	3197.2	3200.0	3203.4	3207.9	3213.3
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1861.7	1989.2	2098.7	2193.0	2289.8	2396.8	2583.9	2779.6	2984.3	3196.5
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-404.6	409.9	918.7	961.0	1004.4	1052.3	1135.6	1222.8	1314.0	1409.3
PROFIT(After Tax):$(1000)	312.0	1086.2	2286.3	1579.3	1180.0	1232.0	1285.5	1344.6	1448.3	1556.8	1670.4	1789.2
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1790.5	1094.5	723.7	668.7	617.4	571.5	544.8	518.2	492.1	466.4
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-3996.5	-2417.2	-1237.2	-5.2	1280.2	2624.8	4073.1	5629.9	7300.3	9089.5
(based on profit NPV)	-2760.4	-5877.6	-4087.1	-2992.5	-2268.8	-1600.1	-982.7	-411.2	133.6	651.8	1143.9	1610.3

SIMPLE PAYBACK: 4.1 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.4 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 19.14%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.12D Prime Mover: Solar "Mars" gas turbine

ASSUMPTIONS:

Installed Cost:	7681 $(1000)			Elec. Purchase Price:	4.76 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	7681 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	25.11 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	3.76 cents/kWh
Term	6.0 Years	Electrical:	88.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	87.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			908.2	944.6	982.3	1021.6	1062.5	1105.0	1152.5	1202.1	1253.8	1307.7
Electricity Sold:			2135.7	2231.9	2332.3	2437.2	2546.9	2661.5	2794.6	2934.3	3081.1	3235.1
Thermal Use:			1245.8	1272.0	1302.2	1354.8	1411.3	1463.9	1456.5	1448.9	1441.4	1433.9
TOTAL REVENUES: $(1000)			4289.7	4448.5	4616.8	4813.7	5020.7	5230.5	5403.6	5585.3	5776.2	5976.7
EXPENSE												
Fuel:			2223.6	2270.5	2324.3	2418.2	2519.1	2613.0	2599.7	2586.2	2572.7	2559.4
O&M:			198.6	207.6	216.9	226.7	236.9	247.5	259.9	272.9	286.5	300.9
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2483.7	2542.3	2608.3	2715.0	2829.2	2937.1	2940.0	2943.5	2947.9	2953.3
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			1806.1	1906.2	2008.5	2098.7	2191.5	2293.3	2463.6	2641.8	2828.2	3023.3
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-438.1	373.1	678.7	919.2	960.8	1006.4	1082.3	1161.7	1244.8	1331.6
PROFIT(After Tax):$(1000)	312.0	1086.2	2244.2	1533.1	1129.8	1179.5	1230.7	1287.0	1381.3	1480.1	1583.5	1691.7
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1757.5	1062.5	692.9	640.2	591.1	547.0	519.6	492.7	466.5	441.0
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-4038.6	-2505.5	-1375.7	-196.2	1034.5	2321.4	3702.7	5182.8	6766.3	8458.0
(based on profit NPV)	-2760.4	-5877.6	-4120.1	-3057.5	-2364.6	-1724.4	-1133.3	-586.3	-66.7	426.0	892.5	1333.5

SIMPLE PAYBACK: 4.3 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.7 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 13.16%
(Based on 10 Years)

COGENERATION SYSTEM CASH FLOW ANALYSIS

PLANT CODE NO..MBEL-3.12E Prime Mover: Solar Mars gas turbine

ASSUMPTIONS:

Installed Cost:	7681 $(1000)			Elec. Purchase Price:	4.76 cents/kWh
Loan Amount:	0 $(1000)	Size:	8589.0 kW	Initial Fuel Cost:	2.83 $/MMBtu
Down Payment	7681 $(1000)	Gross Heat Rate:	11165.0 Btu/kWh	Boiler Efficiency:	79.20 %
Loan Terms:		Usable Heat:	5011.0 Btu/kWh	Elec. Used On Site:	27.40 %
Int.	12.0 %	Load Factors:		Electricity Sale Price:	4.94 cents/kWh
Term	6.0 Years	Electrical:	96.0 %	Construction Period:	2.00 year(s)
Discount Rate:	13.0%	Thermal:	87.0 %	O&M Charge:	0.30 cents/kWh
IRR Guess:	40.0%				

YEAR:	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
REVENUE												
Displaced Electricity:			1081.2	1124.4	1169.4	1216.2	1264.8	1315.4	1372.0	1430.9	1492.5	1556.7
Electricity Sold:			2590.5	2590.5	2590.5	2590.5	2590.5	2590.5	2590.5	2590.5	2590.5	2590.5
Thermal Use:			1245.8	1272.0	1302.2	1354.8	1411.3	1463.9	1456.5	1448.9	1441.4	1433.9
TOTAL REVENUES: $(1000)			4917.4	4986.9	5062.1	5161.4	5266.6	5369.8	5418.9	5470.3	5524.3	5581.0
EXPENSE												
Fuel:			2425.7	2476.9	2535.6	2638.1	2748.1	2850.6	2836.0	2821.3	2806.6	2792.0
O&M:			216.7	226.4	236.6	247.3	258.4	270.0	283.5	297.7	312.6	328.2
P&I:			0.0	0.0	0.0	0.0	0.0	0.0				
Insurance:			61.4	64.2	67.1	70.1	73.3	76.6	80.4	84.4	88.6	93.1
TOTAL EXPENSES: $(1000)			2703.9	2767.6	2839.4	2955.5	3079.8	3197.2	3200.0	3203.4	3207.9	3213.3
TAX INCENTIVES:												
PROFIT (Pre Tax):$(1000)			2213.5	2219.4	2222.7	2206.0	2186.8	2172.6	2218.9	2266.9	2316.5	2367.7
[Depreciation]:(Class 34)	691.3	2419.5	2765.2	1036.9								
[Depreciation]:Class 3(4%)	12.3	30.2	29.0	27.9	26.7	25.7	24.7	23.7	22.7	21.8	20.9	20.1
TAXES: 44.34 percent	-312.0	-1086.2	-257.5	511.9	973.7	966.7	958.7	952.8	973.8	995.5	1017.8	1040.9
PROFIT(After Tax):$(1000)	312.0	1086.2	2471.0	1707.4	1249.0	1239.2	1228.1	1219.8	1245.1	1271.4	1298.6	1326.8
PROFIT PRESENT VALUE (After Tax):$(1000)	312.0	961.3	1935.1	1183.3	766.0	672.6	589.9	518.5	468.4	423.2	382.6	345.9
CUMULATIVE CASH FLOW (NPV): $(1000)	-2760.4	-6282.8	-3811.8	-2104.4	-855.4	383.8	1611.9	2831.7	4076.9	5348.3	6646.9	7973.7
(based on profit NPV)	-2760.4	-5877.6	-3942.4	-2759.1	-1993.1	-1320.5	-730.6	-212.1	256.3	679.5	1062.1	1407.9

SIMPLE PAYBACK: 4.4 years
(Based on 10 Year After-Tax Average)
DISCOUNTED PAYBACK: 8.6 years
(Based on 10 Year After-Tax Average)

INTERNAL RATE OF RETURN: 18.86%
(Based on 10 Years)

4.0 FEEDBACK FROM PLANT PERSONNEL

4.1 Initial Contacts

The first study action was to contact industrial plants to determine their interest in having a mini cogeneration assessment done for their plant on a no-charge basis. It is acknowledged that the reaction of these persons would partially be a function of our success in contacting the most appropriate person within an organization. However, this factor could be partially offset by virtue of the fact that a number of the names were obtained from attendance lists for recent cogeneration conferences and seminars. The reactions fell into three broad groups as follows:

- Not interested in another study.
- Interested in cooperating but didn't follow through with data.
- Good initial interest with follow-through in providing data.

Personnel from the participating plants quite consistently demonstrated a positive attitude towards cogeneration, were knowledgeable of the subject and certainly not intimidated by the prospects of having a cogeneration system operating within their plant.

4.2 Plant Responses to Cogeneration Scenarios

The plant personnel usually reacted with interest to the cogeneration system selections and financial results although their speculation on the corporate acceptance varied greatly.

- Several persons questioned how serious the Electric Utilities were with respect to encouraging cogeneration systems in the private sector.
- Several of the persons understood that their local Electric Utility was not interested in buying electricity from an independent generator.
- A minority of the persons stated that they thought that electrical purchase and sale prices would have to be greater to justify cogeneration systems in their plants.
- Some of the plants have corporate cogeneration system experience in the U.S.A., while only one company had Canadian cogeneration system experience.

- Most of the plant personnel felt that they would require a firm commitment from the Electric Utility regarding terms and conditions of electricity sale. The 1989 Ontario Hydro "Rates for Purchase of Non-Utility Generation in Ontario", Schedules A, B and C, is more specific than previously, with respect to electricity rates and terms, and would satisfy many of the stated needs, if the company was considering a cogeneration system smaller than 5 MW.

4.3 Financial

- Plant comments on financial performance threshold requirements were stated in terms of Internal Rate of Return and Simple Pay-back, with the latter criteria being the most common. Sometimes the threshold requirements were stated in terms of both performance measures, and sometimes the two values were contradictory.

- With one exception, the Simple Pay-back requirements varied from 2 to 4 years, with the concentration of numbers being in the 2 to 3 year range. The one exception was the possibility of the company accepting a five year pay-back to obtain increased electrical supply integrity as a project benefit.

- Threshold Internal Rate of Return values varied from 15-40% with most in the 25-40% range.

- Several companies indicated that the financial performance threshold requirements vary according to whether the company has recently experienced "good" or "marginal" years financially. It is fairly typical for a company to accept one additional year of pay-back time if the overall company financial performance is strong.

- We were often reminded that cogeneration system funding had to compete with production funding, which invariably and logically took priority. With this as background, several firms identified a certain limit to the capital cost expenditure, for a nonproduction project to be accepted.

4.4 Summary

Most of the plant personnel demonstrated an interest in pursuing the analysis of cogeneration system opportunities to try to define a system that would meet the plant technical, operational and financial performance requirements.

5.0 ANALYSIS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Financial Analysis Results Matrix

The financial analysis results of all of the scenarios described in Section 3.0 are summarized in the three matrix sheets which follow.

The matrices cover 63 cogeneration system scenarios applied to the twelve industrial plants used as models for the study. The multiple scenarios were provided as a device to help plant personnel appreciate the available options. They introduce a range of available technologies plus electrical and thermal capacity choices, capital cost variations and $/kW installed cost variations. The results are quite varied, as demonstrated by the following:

- Capital cost variations from $501,000 to $48,000,000.
- Capacity variations from 501 kW to 85,140 kW.
- $/kW installed costs of $564 to $3,519.
- On-site use of electricity variations from 8% to 100%.
- Thermal load factors from 48% to 98%.
- IRR values of -1.48 to 30.46%.
- Simple pay-backs (Based on 10 year after-tax average) varying from 2.7 to 10.4 years.

It is very difficult to generalize the likelihood of some cogeneration scenarios obtaining corporate approval and proceeding to the implementation stage. One of the obvious difficulties in projecting financially feasible scenarios within the corporate approval perspective would be the limited time that was available to develop and review the scenarios, and then to work the results through the corporate approval stages. The exercise is further complicated by the loosely stated financial threshold requirements reported in Section 4.3.

Having made the foregoing qualifications, and further qualifying the data with an acknowledgement of the limited number of plants surveyed, the most optimistic expectation for projects proceeding to implementation, under the current rates and contract arrangements would be 3 plants (25%). A more realistic estimate would probably be 2 plants out of the 12 analyzed plants.

COGENERATION SYS

COGENERATION SYSTEM LEGEND

GT – GAS TURBINE
GE – GAS ENGINE
ST – STEAM TURBINE

INDUSTRIAL SECTOR	SCENARIO NUMBER 1	CAPITAL COST (CURRENT $1000) 2	COGENERATION SYSTEM – PRIME MOVER 3	– SUPPLEMENTARY FIRING (YES/NO) 4	– OTHER 5	CAPACITY – KW 6	– STEAM FLOW BASE SYSTEM (1,000 LBS.) 7	– STEAM FLOW WITH SUPPLEMENTARY FIRING 8	LOAD FACTOR – ELECTRICAL (%) 9	10
Group 28 – Chemicals & Allied Products	3.4A	3044	GT	No	–	1920	17.5	–	87.0	86.0
	3.4B	3146	GT	No	–	2485	24.2	–	89.0	79.0
	3.4C	3906	GT	No	–	3743	23.5	–	74.0	73.0
	3.4D	2007	GT/ST	Yes	*	1342	8.6	10.5	99.0	98.0
	3.4E	3211	GT	No	–	1920	17.5	–	99.0	98.0
	3.4F	3249	GT	No	–	2485	24.2	–	99.0	79.0
Group 33 – Primary Metal Industries Group 34 – Fabricated Metal Products, Except Ordnance Machinery & Transportation Equipment Group 35 – Machinery, Except Electrical Group 37 – Transportation Equipment	3.5A	800	ST	No	–	1250	61.0	–	99.0	98.0
	3.5B	8944	GT	Yes	–	8589	42.5	115.2	99.0	98.0
	3.5C	15893	GT	Yes	–	15739	62.3	276.0	99.0	98.0
	3.5D	20136	GT	Yes	–	21480	85.3	207.6	99.0	97.0
	3.5E	21977	GT	Yes	–	26840	130	385.7	98.0	97.0
	3.5F	29601	GT	Yes	–	39240	183	433.8	98.0	82.0
	3.5G	48000	GT	Yes	–	85140	375.0	550.0	64.0	63.0
	3.5H	32839	GT/ST	NO	*	44536	134.0	–	99.0	82.0
Group 32 – Stone, Clay & Glass Products Group 33 – Primary Metal Industries Group 34 – Fabricated Metal Products, Except Ordnance, Machinery & Transportation Equipment Group 37 – Transportation Equipment	3.6A	11655	GT	No	–	15739	62.3	–	96.0	89.0
	3.6B	7512	GT	No	–	8589	42.7	–	99.0	96.0
	3.6C	8944	GT	Yes	*	8589	42.7	88.2	97.0	96.0
	3.6D	12236	GT/ST	NO	*	16609	49.5	–	99.0	93.0
Group 23 – Apparel & Other Finished Products Made From Fabrics & Similar Materials	3.7A	501	GE	No	–	290	1.3	–	50.0	48.0

COGENERATION SYSTEM FACTORS

1

LBS.)

N WITH SUPPLEMENTARY FIRING

D FACTOR – ELECTRICAL (%)

– THERMAL (%)	ELECTRICAL PURCHASE PRICE (¢/KWH)	GAS PURCHASE PRICE ($/1000 FT.)	ELECTRICAL SALE PRICE (¢/KWH)	ON–SITE USE OF GENERATED ELECTRICITY (%)	BOILER EFFICIENCY (%)	INTERNAL RATE OF RETURN (%)	CUMULATIVE NPV (1000$)	10 YEAR AFTER–TAX AVG. PAYBACK (%)	INSTALLED COST/KW ($/KW)	
10	11	12	13	14	15	16	17	18	19	COMMENTS
86.0	4.85	2.70	N.A.	100.0	75.0	10.93	–188.4	5.9	1585	
79.0	4.85	2.70	N.A.	100.0	75.0	14.56	155.1	5.0	1266	
73.0	4.85	2.70	N.A.	100.0	75.0	18.32	689.5	4.3	1044	
98.0	4.85	2.70	N.A.	100.0	75.0	19.58	443.0	4.1	1495	• Combined cycle
98.0	4.85	2.70	2.54	79.0	75.0	9.43	–337.0	6.3	1672	
79.0	4.85	2.70	2.54	79.0	75.0	10.46	–248.2	6.0	1307	
98.0	3.78	3.10	N.A.	100.0	80.0	14.93	50.9	4.8	640	
98.0	3.78	3.10	N.A.	100.0	80.0	19.09	1823.7	4.2	1041	
98.0	3.78	3.10	N.A.	100.0	80.0	21.25	4499.7	3.8	1010	
97.0	3.78	3.10	N.A.	100.0	80.0	18.24	3515.0	4.3	937	
97.0	3.78	3.10	N.A.	100.0	80.0	22.78	7560.1	3.6	819	
82.0	3.78	3.10	N.A.	100.0	80.0	17.52	4465.5	4.4	754	
63.0	3.78	3.10	3.76	87.0	80.0	18.60	9032.0	4.2	564	
82.0	3.78	3.10	N.A.	100.0	80.0	13.07	71.3	5.2	737	• Combined cycle
89.0	4.10	2.79	N.A.	100.0	82.0	21.85	3625.1	3.7	741	
96.0	4.10	2.79	N.A.	100.0	82.0	21.18	2129.7	3.8	875	
96.0	4.10	2.79	N.A.	100.0	82.0	19.54	1974.5	4.1	1041	• Supplemental firing rate has been prorated to suit plant thermal demands
93.0	4.10	2.79	N.A.	100.0	82.0	21.38	3595.9	3.7	737	• Combined cycle
48.0	5.75	4.59	N.A.	100.0	80.0	–0.85	–171.1	10.4	1727	

FINANCIAL ANALYSIS
RESULTS MATRIX

COGENERATION SYSTE

COGENERATION SYSTEM LEGEND

GT – GAS TURBINE
GE – GAS ENGINE
ST – STEAM TURBINE

INDUSTRIAL SECTOR	SCENARIO NUMBER 1	CAPITAL COST (CURRENT $1000) 2	COGENERATION SYSTEM - PRIME MOVER 3	- SUPPLEMENTARY FIRING (YES/NO) 4	- OTHER 5	CAPACITY - KW 6	- STEAM FLOW BASE SYSTEM (1,000 LBS.) 7	- STEAM FLOW WITH SUPPLEMENTARY FIRING 8	LOAD FACTOR - ELECTRICAL (%) 9	- 10
Group 30 Rubber & Miscellaneous Plastic Products	3.1A	7681	GT	No	–	8589	42.5	–	99.0	98.0
	3.1B	7512	GT	No	–	8589	42.5	–	64.0	62.0
	3.1C	3869	GT	No	–	3028	18.6	–	99.0	98.0
	3.1D	3702	GT	No	–	3028	18.6	–	85.0	84.0
	3.1E	4320	GT	Yes	–	3028	18.6	53.6	99.0	98.0
	3.1F	4737	GT	Yes	*	3743	23.5	39.6	99.0	98.0
	3.1G	7681	GT	No	–	8589	42.5	–	99.0	98.0
Group 28 – Chemicals & Allied Products Group 29 – Petroleum Refining & Related Industries	3.2A	1768	GT	No	–	1000	8.6	–	99.0	98.0
	3.2B	1830	GT	No	–	1275	11.9	–	99.0	98.0
	3.2C	4074	GT	No	–	3743	23.6	–	99.0	98.0
	3.2D	4737	GT	Yes	–	3743	23.6	37.8	99.0	98.0
	3.2E	7681	GT	No	–	8589	42.8	–	99.0	98.0
	3.2F	1201	ST	No	*	600	36.3	–	99.0	98.0
	3.2G	1189	ST	No	*	750	36.5	–	99.0	98.0
	3.2H	1500	GE	No	*	1100	–	–	99.0	98.0
	3.2I	8200	GT/ST	No	*	9519	30.3	–	99.0	98.0
Group 20 – Food & Kindred Products	3.3A	1618	GT	No	–	800	6.5	–	99.0	96.0
	3.3B	1830	GT	No	–	1275	12.0	–	83.0	82.0
	3.3C	3044	GT	No	–	1920	17.6	–	84.0	82.0
	3.3D	1302	ST	No	*	370	16.0	–	98.0	85.0
	3.3E	4274	GT/ST	No	*	4382	27.8	–	99.0	67.0
	3.3F	2590	GT/ST	No	*	2458	13.7	–	97.0	96.0
	3.3G	830	GE	No	–	550	2.0	–	95.0	94.0

ON SYSTEM FACTORS

ARY FIRING

RICAL (%)

- THERMAL (%) 10	ELECTRICAL PURCHASE PRICE (¢/KWH) 11	GAS PURCHASE PRICE ($/1000 FT.) 12	ELECTRICAL SALE PRICE (¢/KWH) 13	ON-SITE USE OF GENERATED ELECTRICITY (%) 14	BOILER EFFICIENCY (%) 15	INTERNAL RATE OF RETURN (%) 16	CUMULATIVE NPV (1000$) 17	10 YEAR AFTER-TAX AVG. PAYBACK (%) 18	INSTALLED COST/KW ($/KW) 19	COMMENTS
.0	4.50	3.10	2.54	64.0	81.5	16.95	1001.7	4.5	894	
.0	4.50	3.10	N.A.	100.0	81.5	13.82	194.0	5.2	875	
.0	4.50	3.10	2.54	85.0	81.5	11.81	-141.0	5.6	1278	
.0	4.50	3.10	N.A.	100.0	81.5	11.86	-128.6	5.6	1223	
.0	4.50	3.10	2.54	85.0	81.5	15.23	306.8	4.9	1427	
.0	4.50	3.10	2.54	82.0	81.5	15.44	370.2	4.8	1265	• Supplemental Firing Rate has been prorated to suit plant thermal demands
.0	4.50	3.10	N.A.	100.0	81.5	23.33	2823.3	3.5	894	
.0	4.40	2.83	N.A.	100.0	80.0	6.62	-317.5	7.2	1768	
.0	4.40	2.83	N.A.	100.0	80.0	11.01	-109.6	5.8	1432	
.0	4.40	2.83	3.76	32.0	80.0	16.52	471.2	4.6	1088	
.0	4.40	2.83	3.76	32.0	80.0	15.22	336.9	4.8	1266	
.0	4.40	2.83	3.76	14.0	80.0	19.27	1650.0	4.1	894	
.0	4.40	2.83	N.A.	100.0	80.0	-1.48	-431.0	10.8	2002	• Includes new Boiler
.0	4.40	2.83	N.A.	100.0	80.0	6.79	-209.9	7.1	1585	• Includes new boiler
0	4.40	2.83	N.A.	100.0	80.0	1.38	-455.8	9.3	1364	• 125 ton absorption chiller
.0	4.40	2.83	3.76	12.6	80.0	17.23	1164.7	4.4	861	• Combined cycle
.0	4.31	3.44	N.A.	100.0	80.0	1.86	-469.3	9.1	2022	
0	4.31	3.44	N.A.	100.0	80.0	4.71	-415.2	7.9	1435	
.0	4.31	3.44	N.A.	100.0	80.0	2.81	-835.7	8.7	1585	
.0	4.31	0.19	N.A.	100.0	80.0	2.43	-356.1	8.9	3519	• Plant waste fired boiler
.0	4.31	3.44	3.76	38.0	80.0	9.25	-483.7	6.2	975	• Combined cycle
0	4.31	3.44	N.A.	100.0	80.0	11.08	-152.2	5.8	1054	• Combined cycle
0	4.31	3.44	N.A.	100.0	80.0	0.98	-257.3	9.5	1509	

FINANCIAL ANALYSIS
RESULTS MATRIX

COGENERATION SYSTEM F

COGENERATION SYSTEM LEGEND

GT – GAS TURBINE
GE – GAS ENGINE
ST – STEAM TURBINE

INDUSTRIAL SECTOR	SCENARIO NUMBER 1	CAPITAL COST (CURRENT $1000) 2	COGENERATION SYSTEM – PRIME MOVER 3	– SUPPLEMENTARY FIRING (YES/NO) 4	– OTHER 5	CAPACITY – KW 6	– STEAM FLOW BASE SYSTEM (1,000 LBS.) 7	– STEAM FLOW WITH SUPPLEMENTARY FIRING 8	LOAD FACTOR – ELECTRICAL (%) 9	– THERM 10	11
Group 20 – Food & Kindred Products	3.8A	4074	GT	No	–	3743	23.6	–	96.0	95.0	4.3
	3.8B	4737	GT	Yes	*	3743	23.6	39.8	96.0	95.0	4.3
	3.8C	7681	GT	No	–	8589	42.7	–	96.0	87.0	4.3
	3.8D	7681	GT	No	*	8589	42.7	–	88.0	87.0	4.3
Group 25 – Furniture and Fixtures	3.9A	1802	GE	No	–	1475	7.9	–	99.0	64.0	5.3
	3.9B	830	GE	No	–	550	2.7	–	99.0	98.0	5.3
Group 20 – Food & Kindred Products	3.10A	4074	GT	No	–	3743	23.4	–	99.0	98.0	4.6
	3.10B	4737	GT	Yes	–	3743	23.4	49.1	99.0	98.0	4.6
	3.10C	7681	GT	No	–	8589	42.5	–	94.0	93.0	4.6
	3.10D	9114	GT	Yes	–	8589	42.5	114.2	93.0	92.0	4.6
Group 28 – Chemicals & Allied Products	3.11A	9114	GT	Yes	–	8589	42.5	102.3	99.0	98.0	3.8
	3.11B	16065	GT	Yes	–	15739	62.3	245.1	99.0	98.0	3.8
	3.11C	20374	GT	Yes	–	21480	84.3	184.3	95.0	94.0	3.8
	3.11D	22235	GT	Yes	–	26840	128.8	342.4	95.0	94.0	3.8
	3.11E	29900	GT	Yes	–	39240	181.1	385.1	95.0	94.0	3.8
	3.11F	43000	GT	Yes	–	85140	370.6	547.8	95.0	94.0	3.8
Group 20 – Food & Kindred Products	3.12A	4074	GT	No	–	3743	23.6	–	96.0	95.0	4.7
	3.12B	4737	GT	Yes	–	3743	23.6	39.8	96.0	95.0	4.7
	3.12C	7681	GT	No	–	8589	42.7	–	96.0	87.0	4.7
	3.12D	7681	GT	No	*	8589	42.7	–	88.0	87.0	4.7
	3.12E	7681	GT	No	–	8589	42.7	–	96.0	87.0	4.7

3

NERATION SYSTEM FACTORS

SUPPLEMENTARY FIRING

OR – ELECTRICAL (%)

– THERMAL (%) 10	ELECTRICAL PURCHASE PRICE (¢/KWH) 11	GAS PURCHASE PRICE ($/1000 FT.) 12	ELECTRICAL SALE PRICE (¢/KWH) 13	ON-SITE USE OF GENERATED ELECTRICITY (%) 14	BOILER EFFICIENCY (%) 15	INTERNAL RATE OF RETURN (%) 16	CUMULATIVE NPV (1000$) 17	10 YEAR AFTER-TAX AVG. PAYBACK (%) 18	INSTALLED COST/KW ($/KW) 19	COMMENTS
95.0	4.3	2.83	3.76	16.10	79.2	15.15	282.4	4.8	1088	• Supplemental firing rate has been prorated to suit plant thermal demands • Electric generation is restricted to match thermal demand.
95.0	4.3	2.83	3.76	16.10	79.2	14.29	193.1	5.0	1266	
87.0	4.3	2.83	3.76	7.04	79.2	17.06	1041.0	4.4	894	
87.0	4.3	2.83	3.76	6.32	79.2	16.37	853.8	4.6	894	
64.0	5.37	4.99	N.A.	100.0	70.0	8.39	−244.9	6.5	1222	
98.0	5.37	4.99	N.A.	100.0	70.0	11.25	−43.9	5.8	1509	
98.0	4.60	2.58	2.54	79.0	80.0	26.09	1954.3	3.2	1088	
98.0	4.60	2.58	2.54	79.0	80.0	24.77	2002.5	3.3	1266	
93.0	4.60	2.58	2.54	37.0	80.0	18.14	1323.0	4.3	894	
92.0	4.60	2.58	2.54	37.0	80.0	18.38	1634.9	4.3	1061	
98.0	3.84	2.55	3.76	79.0	83.0	19.09	1861.9	4.2	1061	
98.0	3.84	2.55	3.76	44.0	83.0	20.85	4339.5	3.9	1021	
94.0	3.84	2.55	3.76	32.0	83.0	18.61	3849.8	4.2	949	
94.0	3.84	2.55	3.76	26.0	83.0	22.32	7323.5	3.6	828	
94.0	3.84	2.55	3.76	17.5	83.0	23.14	10871.6	3.5	762	
94.0	3.84	2.55	3.76	8.0	83.0	30.46	32799.7	2.7	564	
95.0	4.76	2.83	3.76	63.0	79.2	19.2	853.3	4.1	1088	
95.0	4.76	2.83	3.76	63.0	79.2	17.88	764.0	4.4	1266	
87.0	4.76	2.83	3.76	27.40	79.2	19.14	1610.3	4.1	894	• Electric generation is restricted to match thermal demand.
87.0	4.76	2.83	3.76	25.11	79.2	18.16	1333.5	4.3	894	
87.0	4.76	2.83	4.94	27.4	79.2	18.86	1407.9	4.4	894	

FINANCIAL ANALYSIS
RESULTS MATRIX

5.2 Sensitivity Analysis

The purpose of the sensitivity analysis is to demonstrate how changes to one analysis parameter impacts the financial performance of a cogeneration scenario. By systematically adjusting one parameter and re-running a base case scenario it is possible to identify those parameters that have the greatest impact on the financial performance. This, combined with an interpretation of the parameter, helps to quantify the degree of risk in accepting the financial projections and analysis.

The "Sensitivity Analysis Matrix", which follows demonstrates the impact of twenty-two different adjustments to the data for a common cogeneration scenario.

		GAS TURBINE WITH SUPPLEMENTAL FIRING	CAPACITY (kW)	COST ($ 1000)	ANALYSIS PERIOD - CONSTRUCTION (YEARS)	-OPERATION (YEARS)	LOAD FACTOR - ELECTRICAL (%)	- THERMAL (%)	ELECTRICAL PURCHASE PRICE (CENTS/kWh)	FUEL COST ($/MMBtu)	BOILER EFFICIENCY (%)	ELECTRICITY USED ON SITE (%)	ELECTRICITY SALE PRICE (CENTS/kWh)	O&M CHARGE (CENTS/kWh)	ESCALATION FACTORS	- GAS PURCHASE	- ELECTRIC PURCHASE	- ELECTRIC BUY BACK	CCA TIMING	INTERNAL RATE OF RETURN (%)	CUMULATIVE NPV (1000$)	SIMPLE PAYBACK (YEARS)	IMPACT ON INTERNAL RATE OF RETURN	
RUN NO.	BASE SCENARIO		3743	4737	2	10	99	98	4.60	2.58	80.0	79.0	2.54	0.30	REFER TO SECTION 2.4				YEAR OF EXPENDITURE	18.28	827.9	4.3		
S1-A	+ 15% Capital Cost			5448																15.25	389.3	4.9	-0.2% / 1%	
S1-B	- 15% Capital Cost			4026																22.05	1266.6	3.7	+0.25% / 1%	
S2-A	+ 5 Year Analysis Period					15														21.53	2308.9	4.0	+0.65% / Year	
S2-B	- 3 Year Analysis Period					7														13.04	5.1	4.4	-1.75% / Year	
S3	- 5% Elec. Load Factor -5% Thermal Load Factor						94	93												17.12	636.3	4.5	-0.23% / 1%	
S4-A	+ 10% Elec. Purchase Price								5.06											20.71	1246.6	3.9	+0.24% / 1%	
S4-B	- 10% Elec. Purchase Price								4.14											15.70	409.2	4.8	-0.26% / 1%	
S5-A	+ 10% Fuel Purchase Price									2.84										17.82	751.8	4.4	-0.05% / 1%	
S5-B	- 10% Fuel Purchase Price									2.32										18.73	904.0	4.2	+0.05% / 1%	
S6-A	+ 5% Boiler Efficiency										85									16.74	576.9	4.6	-0.31% / 1%	
S6-B	- 5% Boiler Efficiency										75									19.96	1112.4	4.0	+0.34% / 1%	
S7	Wheeling to 2nd Plant Equivalent to 100% Power Being Used On-Site											100								21.10	1315.2	3.9	+0.13% / 1%	
S8	Electricity Sale Price Equal To Preferred Capacity Factor Rate of 3.97 (cents/kWh)												3.97							20.32	1180.2	4.0	+0.04% / 1%	
S9-A	+ 10% O&M Factor													0.33						18.09	797.2	4.3	-0.02% / 1%	
S9-B	- 10% O&M Factor													0.27						18.46	858.6	4.3	+0.02% / 1%	
S10-A	+ 10% Gas Purchase Cost Escalation Factor															+ 10%				18.21	816.0	4.3	-0.007% / 1%	
S10-B	- 10% Gas Purchase Cost Escalation Factor															- 10%				18.34	839.4	4.3	+0.006% / 1%	
S10-C	+ 10% Elec. Purchase Cost Escalation Factor																+ 10%			18.95	948.5	4.2	+0.07% / 1%	
S10-D	- 10% Elec. Purchase Cost Escalation Factor																- 10%			17.60	710.7	4.4	-0.07% / 1%	
S10-E	+ 10% Elec. Sale Price Escalation Factor																	+ 10%		18.39	847.2	4.3	+0.01% / 1%	
S10-F	- 10% Elec. Sale Price Escalation Factor																	- 10%		18.17	809.2	4.3	-0.01% / 1%	
S11	CCA Begins Year of Operation																		Year of Operation	15.54	476.8	4.8	-2.74%	

SENSITIVITY ANALYSIS MATRIX

The "Sensitivity Analysis Matrix" permits some useful comments and generalities to be offered, as follows:

- S1-A & B - Not surprisingly, capital cost is important.
- S2-A & B - The length of the analysis period is really a question of corporate policy. It is noted to be significant.
- S3 - Matching the cogeneration system to the plant electrical and thermal demands is important, to obtain high and similar load factors on the system operation.
- S4-A & B - The cost of electricity paid by the plant is quite significant.
- S5-A & B - Fuel price changes are not so significant, because the system thermal benefit offsets much of the fuel expense change.
- S6-A & B - The efficiency of the boiler from which steam is being displaced by the cogeneration system is quite important in the financial analysis. However, this is a generally constant number that can usually be accurately identified by existing plant instrumentation.
- S7 - The ability to get the full electrical purchase price benefit on all generated electricity is very important. Where a second plant exists in the province, wheeling facilitates this objective and enhances the financial performance.
- S8 - This particular scenario was only selling 21% of generated electricity, back to the Electric Utility. If the 1989 preferred "Capacity Factor" rate of $0.0397/kWh was available the Internal Rate of Return would increase by more than 2%.
- S9-A & B - The Operating and Maintenance factor only has a modest impact as it varies.
- S10-A to F - Changes in the escalation factors have only a modest impact on the financial results. The results are least sensitive to fuel cost changes because of the previously stated offsetting thermal benefit, and because some of the escalation factors are negative values.

- S11 - The proposed legislation to delay the start of CCA claims to the first year of operation would have a significant detrimental impact. In this example the Internal Rate of Return decreases by almost 3%.

The sensitivity matrix provides a column entitled "Impact on Internal Rate of Return". In effect this states the per cent impact on the Internal Rate of Return for each per cent change to the sensitivity factor. This ratio can be biased by the nature of the base scenario. Thus, it is undesirable to regard these ratios as highly accurate numbers that can be generalized. However, they do demonstrate some useful trends. It is worthwhile to review the sensitivity cases to specifically address two factors as follows:

- Identify the factors that are most significant and must be regarded with the greatest care.
- Identify what might be done to improve a factor or alleviate investor concern about same.

Run Number	**Sensitivity Factor**	**Comments**
S1-A & B	Capital Cost	Capital cost is significant with a 10% change affecting the IRR by 2 percentage points. The confidence level in the capital cost estimate could be increased with greater engineering analysis which could be paid for by government. The capital cost could also be reduced by government subsidy.
S2-A & B	Analysis Period	Increasing the analysis period by 5 years increased the IRR by more than 3 percentage points, which is significant. This demonstrates the importance of the Electric Utilities and Fuel Suppliers providing long term contracts that continue to provide the necessary financial leverage to ensure continuing acceptable financial performance. By obtaining fuel and electricity pricing guarantees for 15 years and based on the nature of the equipment it should be reasonable to perform the financial analysis over a 15 year period.

Run Number	Sensitivity Factor	Comments
S3	Electrical and Thermal Load	A high thermal load factor is an important factor for ensuring that the cash flow from a capital investment satisfies threshold requirements. This is a function of the plant thermal load requirements and the size of the cogeneration system being evaluated. The thermal load served by the cogeneration system should preferably be steady. Detailed engineering analysis can increase the accuracy of the calculated factors to improve investor confidence.
S4-A & B	Electrical Purchase Price	This factor affects the value of the displaced electricity, and is significant for most of the selected cogeneration scenarios. Electrical purchase price increases would significantly improve the cogeneration system financial feasibility, but no company would accept this suggestion as being acceptable. From an economic and social viewpoint the gradual increase in electrical prices relative to the prevailing fuel prices would encourage independent generation, with its related benefits.
S5-A & B	Fuel Purchase Price	For gas turbine installations, the usable heat roughly varies from 30 to 75 per cent of the gross heat input depending on the hardware. This means that the results are less sensitive to natural gas cost adjustments than to electrical purchase price charges. The deregulation of the natural gas industry has resulted in competitive rates which are not likely to significantly decrease further. However, the scenario data demonstrated natural gas price variations exist and that they do influence the viability of scenarios.
S6-A & B	Boiler Efficiency	This is strictly a function of the existing boilers within the plant, and although it is significant it cannot normally be changed materially by the plant or by government.

Run Number	**Sensitivity Factor**	**Comments**
S7	Wheeling	This factor is significant in this particular sensitivity run and would be greater if the base case "Electricity Used On-site" was significantly less than 79%. "Unless there are serious physical impediments (eg. lack of distribution or transmission capability), on request, Ontario Hydro will wheel capacity power of 25 kW or more for a parallel generator to another service in Ontario owned by the parallel generator".
S-8	Electricity Sale Price	This factor is significant and would be more apparent with a base scenario in which the "Electricity Used On-site" was lower. Resolution of the highly debated Ontario Hydro "avoided cost" issue in itself would be useful, in that the government could then embark on a program to communicate the fairness of the calculated amount, and the fact that it was no longer a contentious issue. Resolution of the avoided cost issue with an electricity sale price increase would definitely enhance the possibilities for cogeneration system implementation.
S9-A & B	Operating and Maintenance Allowance	This factor has a minor effect on the final results.
S10-A & B	Gas Purchase Cost Escalation Factor	Changes to this factor have little impact on the financial performance. The sensitivity run is, of course, also influenced by the selected gas escalation factors.
S10-C & D	Electrical Purchase Price Escalation Factor	This escalation factor is more significant than the foregoing Gas Purchase and Operating and Maintenance escalation factors. This factor would help to justify cogeneration system installations if it could be legitimately increased.
S10-E & F	Electrical Sale Price Escalation Factor	This escalation factor does not have a major influence on the financial performance. It should be noted that the "Electricity Used On-site" factor

		has a significant bearing on the relative effects of these escalation factors.
S11	Commencement of Class 34 Accelerated CCA	Delay in the CCA claim to the first year of operation would be a very undesirable policy, because of the significant impact on the IRR.

Ontario Hydro introduced "time of use" or "annual time-differentiated rates" for 1989. This occurred at the end of the report assignment and was not the basis for financially analyzing the cogeneration scenarios. It is understood that the 1989 rates and terms applicable to cogeneration system evaluations, plus other general information, will be published by Ontario Hydro during the summer of 1989. A collection of miscellaneous documents obtained from Ontario Hydro is provided in Appendix 'A' as an interim data source.

A limited number of cogeneration system scenarios were evaluated using the 1989 annual time-differential rates. The results suggest the following:

- The financial performance is comparable to that which was obtained using the 1988 rates and terms.

- Consideration should be given to operating the cogeneration system only during the peak periods. However, it may be necessary to operate beyond the weekday 7:00 A.M. to 11: P.M. hours to preserve the demand charge savings.

5.3 Analysis of Plant Reactions

The reactions of the plant personnel were varied and, in many cases, difficult to interpret precisely. The most crucial items relative to encouraging private sector cogeneration applications are as listed below:

- Plant personnel expressed concerns about the Electric Utilities, with respect to independent generation projects. Their comments, which were probably based on some direct contact with the Electric Utility as well as perceptions obtained from publicly available information, were as follows:

    - The Electric Utilities are not perceived to be overly interested in independent cogeneration systems.

    - There is a feeling of apprehension relative to negotiating with a "monopoly".

    - The plant personnel believe that electricity buy-back rates are unduly biased in favour of the Electric Utility.

    - Because of a lack of specific knowledge some plant personnel expressed concern about whether long term arrangements are available with the Electric Utility, with respect to accepting surplus power at predetermined rates.

These points can be rebutted most effectively rebutted by Ontario Hydro's publication of clearly stated rates, contract terms and long term contract details, and through a publicity program that communicates this information effectively to the potential independent cogeneration proponents.

- There is a common perception by plant personnel that the Municipal Electric Utilities are not interested or even willing to cooperate with cogeneration installations. We did not learn of any Municipal Electric Utilities that were actively encouraging the concept and direct contacts varied from "we have no policy but probably would follow that identified by Ontario Hydro" to the extreme position of "we are not interested in buying electricity".

- A common feeling is that "electricity buy-back rates are unrealistically low". This perception is hardly surprising when one reads the material available on the issue of the Ontario Hydro calculated avoided costs. This is further supported by reading the recently published Select Committee on Energy report entitled "Report on Ontario Hydro Draft Demand/Supply Planning Strategy (January 1989)". The report clearly demonstrates the controversy that exists over the avoided cost calculations, even when Ontario Hydro and international experts are able to discuss the issue.

5.4 Conclusions

Based on investigations within the plants, interviews with plant personnel, analysis of a number of cogeneration system scenarios, reading of recent pertinent papers and reports, and discussion with persons associated with the overall exercise, we offer conclusions as follows:

- Plant personnel are reasonably knowledgeable with respect to cogeneration system opportunities, and they generally have a positive attitude towards the potential implementation.

- The Electric Utilities are beginning to create an image of genuine interest in cogeneration systems. However, this interest must be consolidated and more effectively communicated. The fact that the local P.U.C. or Ontario Hydro is committed to buy-back power from a suitably connected independent generator must be communicated.

- Ontario Hydro arbitrarily use 5 MW as the largest sized cogeneration system for which predetermined and published rates are available. This is very restrictive in terms of evaluating a reasonable cross-section of cogeneration systems and capacities. The limit should be increased to a much larger arbitrary number.

- The natural gas industry is understandably interested in the development of an independent cogeneration industry, and is facilitating the implementation of cogeneration systems by providing lower priced natural gas, with specified escalation rates. The Gas Utilities are also directly promoting cogeneration systems with their customers.

- Proponents of independent cogeneration systems will voluntarily move forward, once acceptable electrical rates and contract terms are clearly established and made public, for all sizes of systems up to a value greater than the current 5 MW limit.
- The question of avoided cost calculations must be resolved and communicated to all potential cogeneration system proponents, to eliminate the current and unfortunately consistent perception of the rates and terms being biased strongly in favour of the Electric Utilities.
- Some plants were found to have thermal loads that could be suitable for supporting viable cogeneration systems, but concern was expressed about the corporate willingness to divert capital funding to nonproduction projects. This demonstrates the need to encourage third party financiers.
- Delaying the commissioning of a cogeneration system downgrades the financial performance. Since the financial performance for many scenarios is already marginal, it is crucial that delays external to the private investor be minimized.
- Good thermal use characteristics are essential to achieve financial viability for cogeneration scenarios. It can be accurately stated that plants which do not have process thermal requirements that could be serviced by cogeneration system heat will not be good candidates. It cannot be stated that plants having year-round process thermal requirements can support cogeneration projects that are financially feasible. However, plants with year-round thermal requirements are worthy of careful investigation. Larger, year-round thermal loads permit testing for feasibility with more types and costs of systems, to facilitate obtaining better results. Plant location is not a determining factor.

Class 34 accelerated Capital Cost Allowances are available to a third party financier. However, the creation of a loss from the allowance would have to be reviewed with Revenue Canada.

APPENDIX A

Ontario Hydro Parallel Generation Information

Ontario Hydro will publish updated descriptive material related to parallel generation during the summer of 1989. Current information is as follows:

> "Ontario Hydro Parallel Generation Connection Procedure & Requirements"
>
> "Ontario Hydro Parallel Generation Power Purchase Rates"
>
> "Ontario Hydro Parallel Generation Purchase & Contract Conditions"

Some of the 1989 Ontario Hydro rates and terms material is provided for reference purposes as follows:

- "Direct Customer Rates For 1989"
- "1989 Rates For Supplementary Power"
  (Not applicable for third party financiers)
- Schedule 'A' - "Rates for Purchase of Non-Utility Generation in Ontario"
- Schedule 'B' - "Sliding Scale Purchase Rates"
- Schedule 'C' - "Terms and Conditions of Service" Applicable to Rates

EFFECTIVE JANUARY 1, 1989

ONTARIO HYDRO

DIRECT CUSTOMER RATES FOR 1989

	Monthly Rate per kW $	
	Summer	Winter
230 kV		
Firm	7.10	9.02
Interruptible	6.16	8.08
Excess	8.88	11.28
115 kV		
Firm	7.37	9.29
Interruptible	6.43	8.35
Excess	9.21	11.61
Less Than 115 kV		
Firm	8.06	9.98
Interruptible	7.12	9.04
Excess	10.08	12.48

Energy Rate per kW.h (cents)

Summer		Winter	
On Peak	Off Peak	On Peak	Off Peak
2.79	1.86	3.06	2.39

MAJOR ACCOUNTS DEPARTMENT

EFFECTIVE JANUARY 1, 1989

ONTARIO HYDRO

1989 Rates for Supplementary Power

Supply Voltage	Supplementary Power Demand Rate ($/kW/Day)	
	Summer	Winter
230 kV	0.42	0.54
115 kV	0.44	0.55
Less than 115 kV	0.48	0.59

Energy Charge in cents per kilowatt hour.

	Summer	Winter
On Peak	2.79	3.06
Off Peak	1.86	2.39

MAJOR ACCOUNTS DEPARTMENT

Schedule 'A'

Rates for Purchase of Non-Utility Generation in Ontario

The rates specified below are applicable to new projects coming into service in 1989 delivering up to 5 MW of net capacity, except deliveries on an occasional basis only.

Option 1: Annual Standard Purchase Rates

For capacity factors of 65% or greater - 3.97 cents/kWh
For capacity factors below 65% - 2.54 cents/kWh

Based on the rated kilowatt capacity of the generator or the peak measured in kilowatts delivered in the demand interval of the month.

Option 2: Fixed 10-Year Purchase Rate for New Renewable Resources Based Projects

For capacity factors of 65% or greater - 4.94 cents/kWh
For capacity factors below 65% - 2.54 cents/kWh

Option 3: Annual Time-Differentiated Rates Applicable to All Projects (Independent of Capacity Factor)

Winter Peak	5.87 cents/kWh
Winter Off-Peak	2.50 cents/kWh
Summer Peak	5.28 cents/kWh
Summer Off-Peak	1.72 cents/kWh

Option 4: Time-Differentiated Fixed 10-Year Rates for New Renewable Resource Based Projects (Independent of Capacity Factor)

Winter Peak	6.96 cents/kWh
Winter Off-Peak	2.97 cents/kWh
Summer Peak	6.25 cents/kWh
Summer Off-Peak	2.04 cents/kWh

Rates for Purchase from Direct Customers (Over 5,000 kW) Delivering Energy to the Bulk Electricity System on An Occasional Basis Only

Winter Peak	3.06 cents/kWh
Winter Off-Peak	2.39 cents/kWh
Summer Peak	2.79 cents/kWh
Summer Off-Peak	1.86 cents/kWh

Time of Use

Winter	October through March
Summer	April through September
Peak Period	7:00 am to 11:00 pm weekdays
Off-Peak Period	11:00 pm to 7:00 am weekdays, plus all weekends and public holidays

Schedule 'B'

Sliding Scale Purchase Rates

a) Annual Standard Purchase Rates

For capacity factors of 75% or greater - 3.97 cents per kWh

For capacity factor between 50% and 75%, the following formula applies:

Payment = [2.54 x E] + [1.43/25 x (ACF% - 50%) x E]

Where

- 2.54 is the rate applicable to capacity factors below 50% in cents/kWh
- E is the energy delivered in the month in kWh
- 1.43 is the difference between the rate above 75% capacity factor and the rate below 50% capacity factor (1.43 = 3.97 - 2.54) in cents/kWh
- 25 is the percent value of the capacity factor interval considered (50% to 75%)
- ACF is the actual monthly capacity factor or 75% whichever is less
- 50% is the initial value of the capacity factor interval considered

For capacity factors below 50% - 2.54 cents per kWh is applicable

The monthly capacity factor is based on the rated kilowatt capacity of the generator or the peak measured in kilowatts delivery in the demand interval of the month.

b) Fixed 10-Year Purchase Rate for New and Existing Small Hydro Projects

For capacity factors of 65% or greater - 4.94 cents per kWh

For capacity factors between 50% and 65%, the above formula applies.

Schedule 'C'

Terms and Conditions of Service Applicable to Rates

The terms and conditions of service specified below are applicable to projects up to 5 MW of net capacity.

Standard Purchase Rate

For monthly capacity factor of 65% or greater, the rate set out in the contract between the non-utility generator and Hydro would be indexed annually at Ontario CPI for an initial period of 10 years from the in-service date.

For monthly capacity factors of below 65%, the rate would be reviewed annually by Ontario Hydro.

Time-Differentiated Rates

The rates set out in the contract between the non-utility generator and Hydro would be indexed annually at Ontario CPI for an initial period of 10 years from the in-service date.

Fixed 10-Year Purchase Rate

To be eligible for the 10-year fixed rate projects must be based on renewable resources; including water power, solar, wind, wood-waste, and municipal solid waste.

Projects must provide new power generation capacity. This rate has a front-end loading feature to financially assist the development of new renewable resources based projects. Excluded are existing plants even if they change ownership, unless:

a) the plant has been out of service for at least five years; or
b) the plant has been extensively redeveloped or rehabilitated with at least a 25% increase in power capacity and annual energy production.

Projects must be reviewed to assess Hydro's financial exposure during the fixed rate term. Projects assessed as "risky" will be required to post financial surety equivalent to the advance payments.

Minimum Purchase Rate

For standard purchase rates and 10-year fixed rates corresponding to capacity factors at or above 65% new contracts which typically have 20 year terms will include floor rates defined as follows:

- the floor rates for the initial rate defined period (10 years) will be the rates in the in-service year;

- for the remaining contract term (beyond ten years) the floor rates shall be the higher of:

Schedule 'C'
(cont'd)

1) the rates in the in-service year or
2) the rates in the last year of the initial rate defined period (year 10) or
3) the rates approved by Hydro's Board of Directors at the in-service date, adjusted annually by Ontario CPI using the year of the in-service date as the base year, for each of the first 10 years.

For standard purchase rates corresponding to capacity factors below 65% and for time-differentiated rates, new contracts will include floor rates defined as follows:

- the floor rates for the initial rate defined period (10 years) will be the rates in the in-service year;

- for the remaining contract term (beyond 10 years) the floor rates shall be the higher of the rates in the in-service year or the rates in the last year of the initial rate defined period (year 10).